Operational Evolution Plan

En Route Congestion

ER-1
Match Airspace Design to Demands

In en route airspace, complex traffic flows can cause bottlenecks and inefficiencies. Increased flexibility is needed to address volume, congestion and weather in en route airspace. Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. In the oceanic and offshore airspace, procedural and technological changes offer opportunities to realign airspace and flows. Oceanic Redesign will include resectorization and new routing within oceanic and offshore airspace, conceptualized and executed in a nationally coordinated manner over all associated facilities.

Key Activities:

North/South Reroutes Design Completion	1/03
High Altitude Phase I Initial Implementation	3/03
ZAN Oceanic Specialty (Ocean Redesign)	8/03

Smart Sheet:
Version 5.0, December 2002

ER-1: Match Airspace Design to Demands

Optimize and redesign en route and oceanic airspace to accommodate complexity and congestion.

Background

The structure of en route airspace has stayed virtually the same for the last several decades. However, demands on this airspace have significantly increased. The number of aircraft has increased, as has the diversity in the performance and type of aircraft operating (e.g., regional jets). Programs such as the North American Route Program (NRP) and Free Flight have increased the number of aircraft flying off structured air routes. These advances create both the need and the opportunity to revamp the airspace to better meet evolving customer service.

In en route airspace, complex traffic flows can cause bottlenecks that impede smooth transition to and from key airports. Increased flexibility is needed to address volume, congestion and weather in en route airspace. Operational efficiency can be compromised without this flexibility. Restrictions are put in place to manage demand for access to en route airspace when levels exceed that which can be handled safely.

In the areas where congestion routinely occurs, the only means presently available to supplement current resources is to add additional sectors (through resectorization and restratification). This requires floor space, sector equipment and spectrum to be available for this temporary resource. New methods for managing and applying needed resources to en route sectors are needed.

Ops Change Description

The National Airspace Redesign (NAR) is the FAA initiative to review, redesign, and restructure the nation's airspace. NAR will leverage new technologies, equipage, infrastructure, and procedural developments to maximize benefits and system efficiencies. Modernization of airspace through NAR is characterized by the migration from constrained ground-based navigation to the freedom of an RNP based system.

There are four components to NAR, three of which will deliver the desired operational change in the design and management of en route airspace:

- ER-1.1: NAR – Regional Optimization and Redesign of En Route Airspace
- ER-1.2: NAR – High Altitude Redesign
- ER-1.3: NAR – Oceanic Redesign

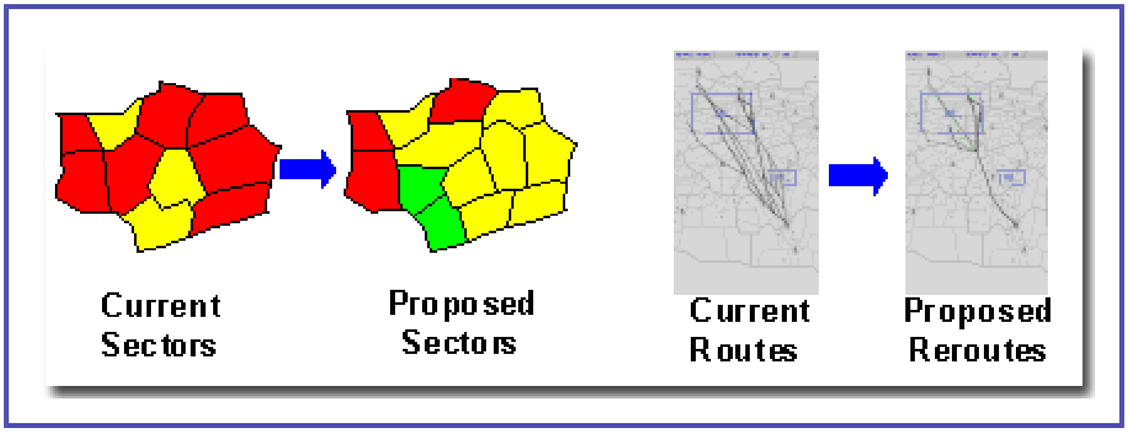
Initially, redesign efforts will focus on optimization of existing resources by splitting and restratifying sectors, potentially creating additional sectors. Later efforts will include larger scale redesign actions, including sectorization concepts that may increase sector size and result in consolidation in the number of sectors. These airspace projects while addressing problems in the en route airspace may include associated changes in the terminal airspace (see AD3).

Benefit, Performance and Metrics

- Reduce en route delay
- Reduce the difference between flight plan time and time as flown
- Reduce the difference between flight plan distance and distance flown
- Increase the percentage of time on filed flight plan versus route flown
- Increase the percentage of time on requested cruise altitude versus altitude flown

- Reduce the time to obtain requested altitude
- Reduce the number of potential conflicts
- Reduce restrictions used to manage sector complexity and congestion

ER-1.1 En Route Airspace Optimization and Redesign



Scope and Applicability

The optimization and redesign of en route airspace consists of two main concepts. The first involves changing the number or size or shape of the sectors in the en route airspace. The second involves adjusting existing routes or developing new routes through these sectors. These techniques can be applied separately or together to alleviate congestion and complexity in the en route airspace. En route restratification, resectorization and rerouting projects are planned for all en route centers in the U.S. Plans have scheduled evolutionary implementation of these airspace projects between 2002 and 2008:

Western Alaska	2002
ZDV Airspace	2003
ZOA/NCT Redesign	2003
ZTL North/South Flows	2003
ZAN Ocean Redesign	2003
ZOA/ZAN Airspace	2003
Caribbean Reroutes	2003
High Altitude Redesign Phase 1 Initial	2003
High Altitude Redesign Phase 1 Expansion	2004
ZKC East End	2004
Interior Alaska	2004
ZLC Area Realignment	2004

ZSE Airspace	2004
High Altitude Redesign Phase 1 Completion	2005
High Altitude Redesign Phase 2 Initial	2005
ZOA Oceanic Airspace 2005	2005
ZMA/ZHU Gulf Reroutes	2005
Southeast Alaska	2005
Western Pacific En Route Bay-to-Basin	2006
High Altitude Redesign Phase 2 Expansion/Completion	2006/ 2007
High Altitude Redesign Phase 3	2008
Great Lakes Corridor	2008

Key Decisions

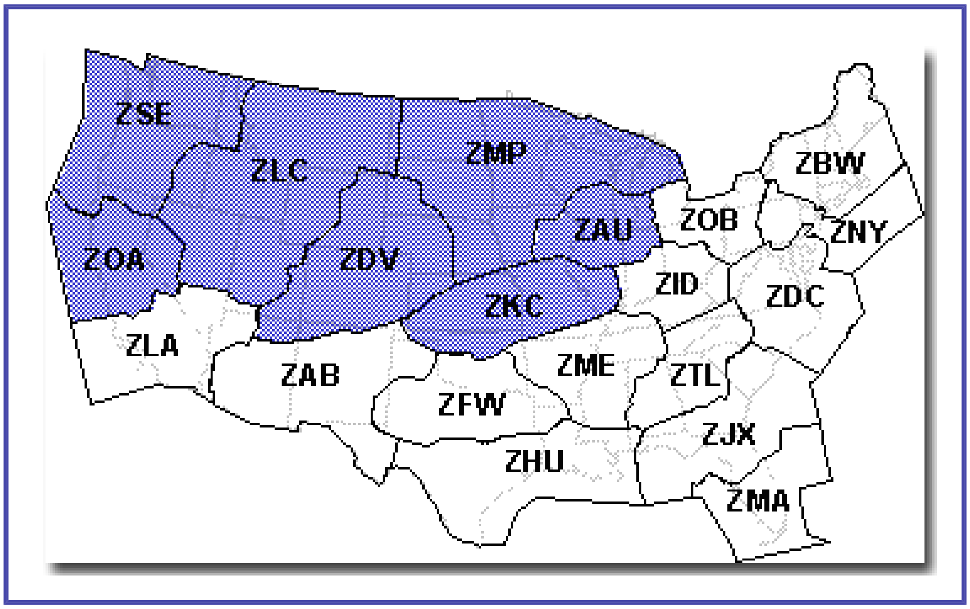
- There are currently over 700 sectors in the NAS, with over 100 additional sectors under consideration. In the near- and mid-term adding or splitting sectors may be the only way to alleviate key areas of congestion in the en route airspace. Air Traffic needs to determine the right level of sectorization, if/when it will need to pursue a strategy to reduce the number of sectors (while addressing the concerns of increased complexity and congestion) and evaluate how evolving technologies can support the reduction of the number of sectors. Any changes in sectorization policies will impact future en route design.
- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
  - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.
  - Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.
  - Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

Key Risks

- Several infrastructure adjustments will be needed to support new sectors, including availability of building space, ATC automation, controller position equipment, and additional frequencies. Lack of availability of these systems may negatively impact the ability to transition to new sectorization or to implement additional sectors. Limitations of the current systems, specifically the HOST computer, will limit potential efficiency of some of the proposed airspace changes. Airspace projects, as they are currently proposed, do not require ERAM. NAR en route projects are scoped to leverage evolving ground and cockpit technologies. Projects described above may require an adjustment to existing infrastructure, but not on technology that does not currently exist. As the NAS modernizes, the airspace will take advantage of those new capabilities.

VTABS (VSCS Training and Backup System) capacity is limited to 50 positions in each en route center. Upgrades and expansion are not available. A proposal for program requirements or funding to provide needed additional capacity is pending. Currently no additional sectors can be added to ZAU (maxed out at 50 positions); ZOB is at 48 positions. Additional sectors are an integral part of several NAR en route projects. If the VTABS issue is not resolved, airspace changes will be delayed.

ER-1.2 Implement High Altitude Redesign



High Altitude Redesign – Phase 1

Scope and Applicability

High Altitude Redesign (HAR) is the primary means to redesign en route airspace. HAR's objective is to provide aviation users the greatest opportunity to operate on their preferred profiles and at efficient altitudes. When fully implemented, HAR will use new airspace concepts and technology to balance flexibility and structure to obtain maximum system efficiency.
HAR uses an evolutionary implementation approach timed to match airspace design, adaptation, automation, and infrastructure development timelines. This approach capitalizes on available technologies to deliver early benefits while concurrently developing the longer-term requirements. These items include sector characteristics, alignment of the airspace with existing and/or new organizational structures, and cognitive and display requirements for modification to decision support tools.

The phased implementation of HAR is as follows:

- HAR Phase 1 is planned for March 2003 and encompasses airspace at or above FL390 in seven centers: ZDV, ZSE, ZOA, ZLC, ZMP, ZKC, and ZAU. Phase 1 will implement three main operational changes:
    - Charted waypoints to efficiently circumnavigate ATCAAs and SUAs
    - Parallel RNAV routes providing structure in capacity constrained airspace (e.g. routes south from Pacific Northwest to California/Nevada)
    - Non-restrictive routing (point-to-point, user-preferred routing) will be possible, enabled by a navigational reference system (NRS) of waypoints
    - When RNP 2.0 becomes available, the following Phase 1 components will be transitioned
    - Procedural separation on SEA/PDX to SFO/LAX/LAS routes
    - Separation from ATCAA's
- The Phase 1 Expansion of NAR has a targeted implementation in 2004. Phase 1 Expansion will be a lateral expansion of HAR, moving into moderate density airspace of ZLA, ZAB, ZFW, ZHU, ZME, ZJX and ZMA. Phase 1 Expansion will exploit the newly established RNP 2 criteria and provide greater connectivity via RNP to key airports in the designated airspace. Vertical expansion will be based on user equipage and will target a floor of FL350.
- Beginning in 2005, HAR will target lowering the altitude floor to below FL350 in the Phase 1 and Phase 1 Expansion airspace, based on user equipage. Phase 1 Completion is planned for late 2005, includes geographic expansion to the Northeast (dependent on the implementation of the NY/NJ/PHL Redesign and the Great Lakes Corridor Redesign). Initial Phase 2 concepts, with reduced RNP values, will be implemented initially in low-density airspace.
- In 2006 and 2007, HAR will continue implementation with Phase 2 Expansion, into moderate density and high-density airspace, respectively.
- Phase 3 of HAR is planned for 2008 and beyond. Functionality and concepts will be finalized in the 2006 timeframe and will be dependent on the maturity of infrastructure improvements such as CPDLC and ERAM.

Later phases of the High Altitude Redesign may incorporate procedural separation on closely space routes enabled by RNP, full domestic RVSM (see ER4), and required time of arrival for transition into en route and terminal airspace.
Phase 1 provides all the characteristics required to evaluate initial changes in procedures and airspace designs. This airspace includes major city pair flows that include high altitude cruise as well as transitioning aircraft from ocean tracks. During the initial implementation, a decision will be made on the most effective next step. That is, whether to proceed by first extending the procedures and designs to lower altitudes within the seven centers or extending procedures and designs across all 20 centers.

Key Decisions

- Users will require access to information on SUA scheduling and usage to allow them to define and file optimal trajectories. This includes information on ATCAA usage. SAMS will be the primary mechanism to provide the data. Procedures and mechanisms for public access to the data are being developed.
- The FAA needs to finalize the expansion plans for the High Altitude Redesign, including the final altitude floor.
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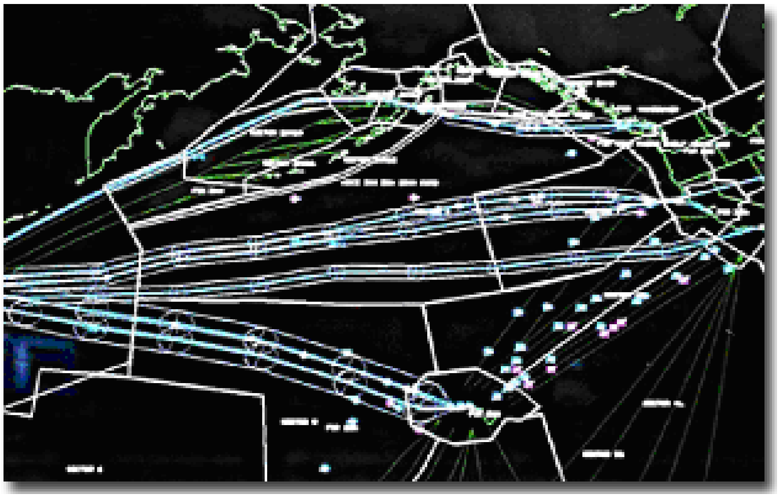
- If the decision is made for mandated equipage (e.g., RNP or RNAV) or exclusionary airspace use, rulemaking will be needed.
- Adoption of a uniform grid naming convention and its inclusion into the en route adaptation will be needed.
- The FAA should decide on the appropriate facility structure (number and size of en route facilities) to effectively support the High Altitude Concept, including management of the staffing, training, automation, displays and infrastructure to support the sectorization.
- The FAA will need to continue development of RNP criteria below RNP 2 (expected in late 2003). HAR Phase 2 concepts currently depend on reduced RNP values.
- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
    - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.
    - Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.
    - Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

Key Risks

- Charting and real-time management of all forms of airspace usage (i.e., ATCAAs) is needed to support development of user-preferred routing that require minimal controller intervention. If the improved information is not available, then the benefit of the charted waypoints will be limited.
- The airspace users face several challenges (database issues, human factors, training, etc) that will limit their ability to be ready for the NRS by March 2003. If they are not capable of using the waypoints, the full benefits of NRR will be limited.
- Several infrastructure adjustments may be needed to support new sectors. If these systems are not available, then it may impact the ability to transition and implement HAR phases:
    - ATC Host/ERAM automation.
    - Frequencies for transitioning and new sectors; enlarging sectors would affect the ground communications infrastructure. Existing radio sites may not provide adequate coverage for the larger sectors, so two or more sites containing radios operating on the same frequency may be required.
    There may be a need to modify surveillance linkages, and existing ground automation systems may not be capable of accepting additional inputs. Other infrastructure considerations include system adaptation and the possible use of new coordinate systems.

Decision support tools (e.g., URET, CRCT capabilities, TMA) may be needed to support the non-restrictive routing and transitioning to and from High Altitude airspace. HAR phases are scoped to leverage evolving ground and cockpit technologies. As the NAS modernizes, the phases will be scoped to take advantage of those new capabilities.

ER-1.3 Oceanic Redesign



A second national-level effort involves oceanic airspace. In next few years, major operational changes will take place in the oceanic domain. Air Traffic must determine how to adjust airspace and procedures to capitalize on these changes and provide the most efficient operations. Oceanic Redesign will include resectorization and new routing within oceanic and offshore airspace, conceptualized and executed in a nationally coordinated manner over all associated facilities.

Scope and Applicability

Oceanic Redesign will leverage state-of-the-art technology, procedures, and programs and support uniformity of oceanic airspace. These airspace projects will focus on overcoming the limitations with how we can most efficiently manage oceanic airspace particularly with human factors, size of sectors, density, and demand for services. Oceanic Redesign will facilitate the implementation of improved airspace structures and procedures along with controller decision support tools for facilities that provide oceanic and offshore services. The planned schedules for Oceanic Redesign projects include:

ZAN Ocean Redesign	2003
ZOA/ZAN Airspace	2003
Caribbean reroutes	2003
ZOA Oceanic Airspace	2005
ZMA/ZHU Gulf Routes	2005

Key Decisions

- The airspace design process under NAR has several points where industry, the user community and other stakeholders are asked to provide input to key decisions. Using informal methods (e.g., briefings and informational meetings) and formal methods (e.g., working with RTCA, advisory committees and public meetings), NAR teams strive to communicate plans and receive appropriate feedback. Ultimately the implementation decision responsibility lies with the FAA. The three critical decision points involving stakeholders are:
    - Characterizing the problem: this activity occurs in the first few months of an airspace project where NAR teams work with stakeholders to affirm project objectives.

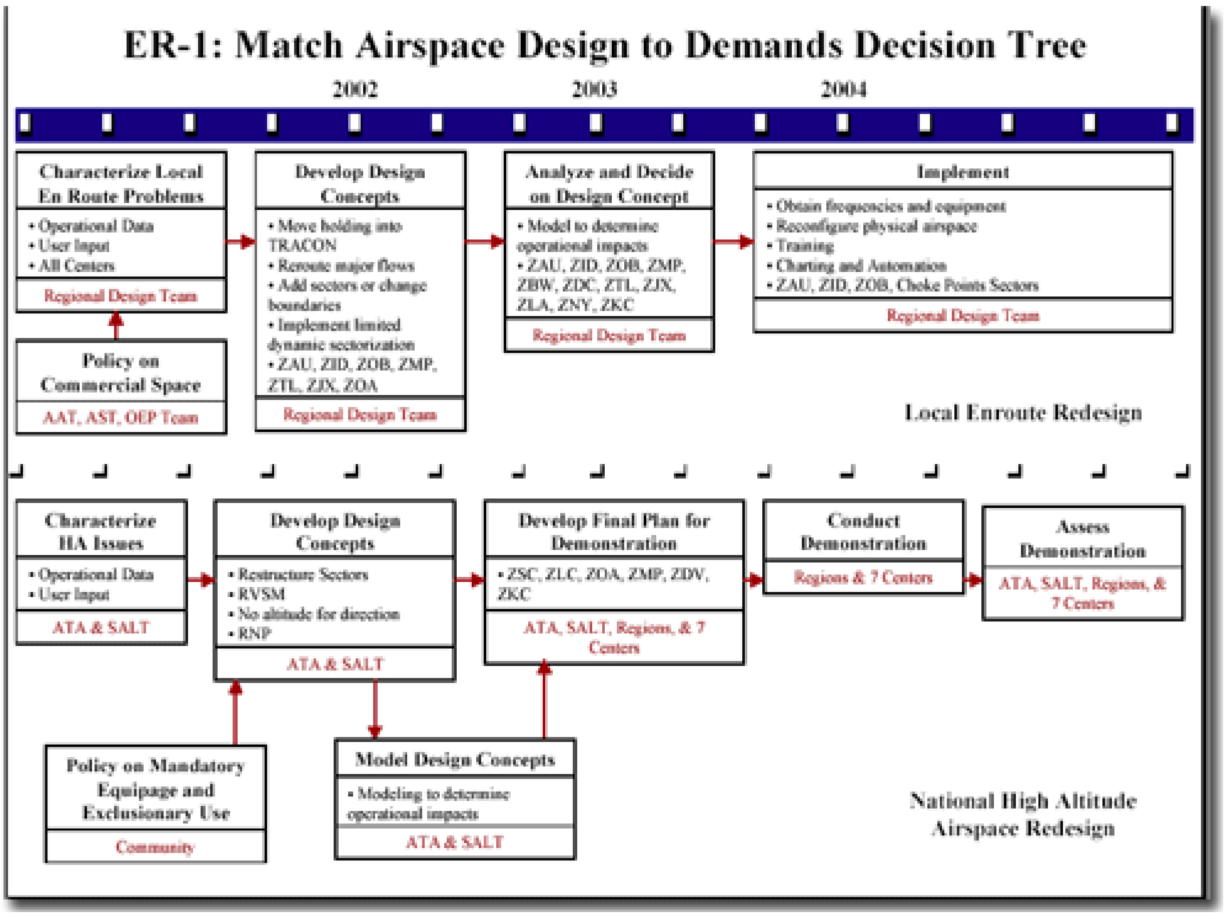
Designing the alternative design options that will become the proposed change: here stakeholders are asked for input through scoping meetings and regular meetings with key constituencies.

Assessing the impact of the proposed change: once analysis has been complete, stakeholders receive feedback on impacts and pending FAA decisions.

Key Risks

None

Decision Tree



[View enlarged decision tree]

Responsible Team

Primary Office of Delivery
Sabra Kaulia, ATA-1
Nancy Kalinowski, ATA-2
Carl Zimmerman, ATA-11
Edie Parish, ATA-3

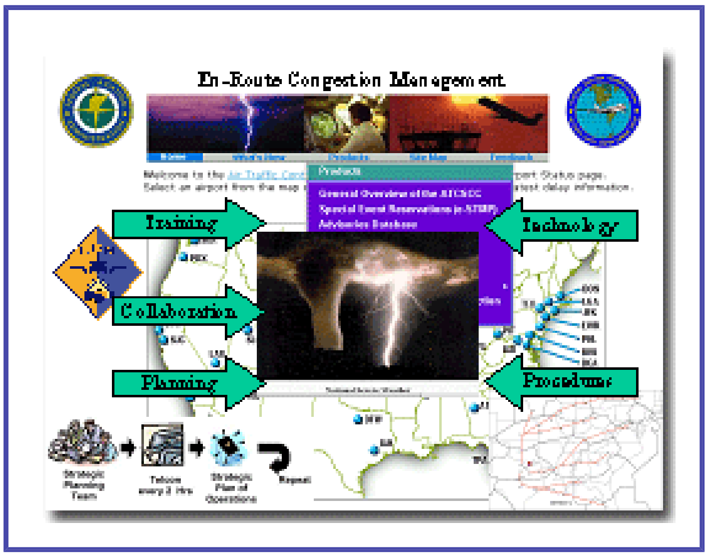
Support Offices
Regional Air Traffic Managers
Regional Air Traffic Airspace and Operations Managers
Regional Airspace Focus Leadership Teams

Facility Airspace Design Teams
ATP-1
ATT-1
AUA-200

Working Forums
RTCA FFSC AWG (and subgroups)
TOARC

Other Websites
[Relationship to the Architecture]
www.faa.gov/ats/nar/
www.faa.gov/ats/atp/RNAV.cfm

ER-2
Collaborate to Manage Congestion



Congestion may appear for brief periods of time at non-routine locations or at different hours of the day. Such congestion may be avoided by sharing predictions with users and allowing them to plan accordingly. Coordination of a game-plan for likely events is done ahead of time to ensure an effective response. Based on results from the collaborative process used for the severe weather season of spring/summer 2002, a program of training has been implemented to prepare controllers, pilots, and airline dispatchers for the spring/summer 2003 activity. Collaborative decision making and information sharing will continue to be emphasized to respond to en route congestion.

Key Activities:

Revised FEA/FCA procedures	May 03
Expand TMNL to all en route centers	2004
DSP R&D Multi Center Ops	2003
FSM Java Client	August 2003

Develop TFM modernization timeline	2003
Reroute Advisory Tool (RAT)	Summer 03
CDM Training Subcommittee	Spring 03
Route Management Tool (RMT) Version 1.3	January 03
ETMS V7.6	May 03

Smart Sheet:
Version 5.0, December 2002

Air traffic congestion can be predicted at major convergence points in the NAS based on airline schedules and historical demand. In addition, congestion may appear at non-routine locations or at different hours based on changing wind configurations, location of hazardous weather conditions, or other dynamic shifts in the norm. Common situational awareness of a predicted congestion area shared by the user and service provider can reveal means to collaborate on mitigation of the constraint. For example, coordination of a game plan for likely events may be done ahead of time to ensure an effective response. Results from the collaborative process used for the severe weather season of Spring/Summer 2000 were used to develop a training program, implemented for Spring/Summer 2001, which prepared controllers, pilots, and airline dispatchers to manage the congestion systemically. Collaborative decision making and information sharing will continue to be emphasized in response to en route congestion for 2003 and beyond.

ER-2: En-Route Congestion Management:

Processes, procedures and techniques to collaboratively mitigate en route congestion, include timely identification of en route impacts, improved route predictability and flexibility.

Background

Certain areas of the National Airspace System (NAS), particularly the area from Chicago to the northeastern U.S. corridor and others east of the Mississippi River, are highly complex and geographically limited. In these areas, traffic increases during peak demand periods combined with decreases in capacity routinely lead to congestion and delays. Even under optimum conditions this can have a ripple effect throughout the NAS.
Balancing capacity and demand in the NAS requires a system wide choreographed effort to minimize service disruption. The Strategic Planning Team (SPT) process, launched by the Spring/Summer 2000 initiative, was designed to foster collaborative solutions. The SPT conducts a telcon among the major facilities and the user community every two hours to discuss the status of the system, constraint projection, and to develop the Strategic Plan of Operations (SPO). The SPO is a collaborative agreement on how to deal with severe weather and other system constraints, and ensure a degree of predictability for all stakeholders by providing a common view of system issues with a look ahead of two to four hours. The Spring of 2000 was the inaugural year for the SPT/SPO process. Significant progress was made during the severe weather season of 2000, and annual reviews of operational rules and processes have resulted in further improvements. Since the inception of the S2K initiative, suggestions were made to enhance and evolve the collaborative process. Changes included increasing specificity in the strategic plan, finding balance in meeting stakeholder objectives, thus reducing the need for tactical initiatives through improved planning; improving communication methods and improving technology and increasing strategic planning telcons to 24 hour coverage.

The Collaborative Decision Making (CDM) Program is a joint Government/Industry initiative to develop new technology and procedures that ensure a safe and efficient NAS, beneficial to everyone in the aviation community and the flying public. CDM focuses on a number of traffic flow management initiatives to create common situational awareness, accurate demand predictions, increased predictability, and improved system planning and execution. The following represents some of the initiatives: National Play book, Coded Departure Routes (CDR), Route Management Tool (RMT), Pathfinder and Diversion Recovery Web pages, Flight Schedule Monitor (FSM), Common Constraint Situation Display (CCSD), Flow Constrained Area (FCA)/Flow Evaluation Areas (FEA), Integrated Traffic Flow Management (ITFM) Traffic Flow Management Core Technologies and Evolution. Working together requires mutual understanding and acceptance of respective roles and responsibilities. CDM initiatives seek to create common situational awareness of traffic congestion and constraints in the national airspace system. With accurate predictions of demand constraints, users can avoid congested routes thereby reducing delays and the need for ATC rerouting. Common situational awareness, or sharing data, benefits both the aviation community and the flying public.

Route management remains relatively inflexible due to rigid airspace design, continued use of ground based Navaids, incompatible databases and automation systems between users' flight planning systems, FAA HOST requirements, and aircraft navigation systems. Advanced aircraft navigation systems have remained largely unused due to an inflexible airspace structure. Poor communication of route and airspace status continues to plague the system resulting in inefficient use of available resources. Additionally, the inability to communicate flight plan changes quickly slows the process and is workload intensive for all stakeholders resulting in increased flight delays.

Ops Change Description

Operational changes will be seen as ongoing improvements in the process of collaboratively managing en route congestion. Traffic Flow Management (TFM) will undergo an evolution that improves identification of constraints, provides common situational awareness, and enhances collaboration on a solution.

The collaborative decision making concept will continue to be refined with decisions distributed among national and local TFM, en route controllers, and Airline Operations Centers (AOCs, a generic term, includes FOCs, OCCs, etc.). Tactical collaboration with NAS users analogous to SPT will be expanded and aimed at improving execution of strategic plans as they are refined tactically to meet changing conditions. Greater focus will be brought to system recovery techniques and mitigation of traffic management initiatives (TMIs) as the need for their use expires.

Improved information on current and forecast traffic, areas of congestion, and weather shared among service providers and NAS users will enable better decisions in reactive, collaborative, and preemptive modes in order to respond to existing and predicted congestion and to prevent congestion from occurring. The mechanisms needed to realize improvements include better planning, procedures, technology (information exchange systems and decision support tools), and training.

Planning: Collaborative Strategic Planning will aid in identification, and common situational awareness of impacted airspace utilizing new technologies will aid in applying solutions. New data-sharing systems and communication-sharing methods, such as the Traffic Management National Log (TMNL), the Air Traffic Control System Command Center (ATCSCC) web site, the Common Constraint Situation Display (CCSD), and the Web Situation Display (WSD) will enhance collaboration for both internal and external traffic managers.

Procedures: Operational changes will include process and procedure improvements as identified through analysis, feedback and review. New technologies will be integrated as they are made available to service providers and users. Route management will be a collaborative effort between the FAA and users to assure flight safety (relative to fuel, hazardous weather, etc.) as well as to assure that traffic volume and complexity concerns are considered to guarantee safe separation of aircraft from aircraft. Activating alternative routes utilizing the National Playbook, Coded Departure Routes, area navigation (RNAV), as well as dynamic utilization of Canadian Routes and military airspace will provide additional options during situations where normal routes are congested or impassable.

Technology:

> **New ETMS functionality:** There will be increased collaboration and greater common situational awareness by utilization of new technologies such as the Flow Evaluation Area (FEA) and Flow Constrained Area (FCA). FEA/FCA functions available to Traffic Management Units (TMUs) on the Traffic Situation Displays (TSD). The NAS user likewise will access and discuss public FCAs through the use of the Common Constraint Situation Display (CCSD), which provides web based access to the Enhanced Traffic Management System (ETMS).
>
> **New FSM functionality:** Enhancements and greater distribution of the Flight Schedule Monitor (FSM) will provide airport traffic demand and capacity maximization capabilities. Improvements in Ground Delay Programs (GDP) functionality and refinement of ground stop (GS) procedures in conjunction with FEA/FCA functionality will provide alternatives to collaboratively manage severe weather constraints in the en-route environment.

Training: S2K+N, yearly training will be an integral part of successful implementation of solutions.

CDM Joint Training subcommittee: The CDM training subcommittee's mission is to develop and implement a joint FAA/Aviation Stakeholder training process to include both initial and recurrent training. The objective of the training is to educate stakeholders on the roles and responsibilities of operating within the NAS. To make an operational change stakeholders will be trained on situational awareness, system planning and application of traffic flow management technologies. This will increase system predictability and performance.

The operational changes are evolutionary and thus will span the entire timeframe of near, middle and long term (2003-2013) and beyond. The sub-groups will address these changes in more detail.

- ER-2.1: Improved collaboration and communication through planning, procedures and data sharing.
  2.1.1 Strategic Planning - S2K+N
  2.1.2 Information, data access and data sharing
- ER-2.2: Route Management (Improve coordination and implementation of alternative routes)
  2.2.1 Re route Advisory Tool (RAT)
  2.2.2 Playbook
  2.2.3 RMT/CDR
  2.2.4 Dynamic utilization of alternative routes through Military airspace
  2.2.5 Dynamic utilization of alternative routes through Canadian airspace
- ER-2.3: Technology:
  2.3.1 Existing technology improvements
  2.3.2 Research and Development
  2.3.3 Systems Integration
- ER-2.4: Training: Joint FAA/Industry Initial and Recurrent Training Process

Benefit, Performance and Metrics

The following metrics may be used to measure NAS system performance.

<u>NAS Level OEP Metrics</u>
Primary: Average delay per flight and average daily flights
Additional NAS Level Metrics:

- Percent of Flights on Time
- Average Minutes of delay per flight
- Ground Stop Minutes/Average Duration
- Ground Delay Program Minutes/Average Duration
- Total Number of Ground Delay Minutes
- Average Daily Arrival Capacity
- Average Daily Flights
- Airport Efficiency Rate
- Average Airborne Delay, Average Block Delay
- Capacity/Throughput (VMC, IMC)
- Total Number of System Delays
- Revenue Passenger Miles, Available Seat Miles

En Route Metrics
Primary:

- Average En Route Delay
- Peak En Route Throughput/Peak En Route Throughput Index (PERTI)

Additional Capacity and Throughput En Route Metrics:

- Percentage of flights flown as filed
- Peak Sector and Center Throughput
- Total, Average, Percentage of Gate Delays
- Rate of Access to SUA
- Average Speed En Route

Additional Efficiency En Route Metrics:

- Average, Total and Minimum Block Time
- Average Block Delay
- Average, Total and Minimum Airborne Time
- Average Airborne Delay
-

- Total Number and Average Duration Ground Stops
- Total Number and Average Duration Ground Delay Programs
- Number of Diversions
- On-Time Performance
- Average, Total, and Minimum Time En Route.

ER-2.1: Improved Collaboration and Communication through Planning, Procedures and Information sharing

Scope and Applicability

The key element underlying ER 2.1 is working together to create system success. Collaboration and common situational awareness derived from collaborative system planning, data sharing methods and CDM programs are expected to produce operational changes throughout the entire time range of the OEP (2003-2013).

Collaborative Decision-Making (CDM) embraces three basic principles, data exchange, distributed planning, and performance analysis.
1. Data exchange. Create common situational awareness through shared information to keep all parties aware of system demand and constraints.
2. Distributed planning. NAS stakeholders can provide input into traffic management decisions to ensure that limited resources are used in a manner that accommodates individual business needs.
3. Performance analysis. CDM uses performance analysis data and experience to further enhance system performance.

The ER-2.1 solution set, "Improved Collaboration and Communication through planning, procedures and information sharing, will focus on the principle elements of CDM and includes the following sub-groups:

2.1.1 Strategic Planning; (SPT) process (S2K+N)
2.1.2 Information, data sharing, and data access between FAA facilities and Users (i.e. Airlines)

2.1.1 Strategic Planning – S2K+N:

The strategic planning process, which was initiated during the spring of 2000, is the foundation of NAS collaboration on a daily basis. Recommendations for yearly improvements are addressed by an S2K+N steering committee. Specific tasks may be requested through other sub-groups or organizations.

Near Term: (2003-2005):

- Evaluate need for "Flexible Rules of Operation" for varying states of the NAS
- Process improvements as identified through lessons learned reviews will be identified and implemented as applicable

Mid Term: (2006 –2009):

- Mid term is dependent on process analysis and feedback from the near term.

Long Term: (2010 –2013):
Undefined

2.1.2 Information, data sharing, and data access between FAA facilities and Industry (i.e. Airlines, NBAA, RAA, Military):

Data exchange is a basic principle of CDM; therefore, the CDM leadership team has identified this item as a key element in the success to operational change.

Information (Data) Sharing Methods:

ATCSCC WEB: Internet
The information provided on the ATCSCC web site, Internet, provides timely NAS status information for use by aviation entities as well as the general public.

ATCSCC WEB: Intranet
The information provided on the ATCSCC web site, Intranet, provides FAA facilities timely NAS status information. CDM participants are provided access to the data through the CDMnet as noted in the following section.

Collaborative Decision Making Network (CDMnet)
The CDMnet is a network routed through the Volpe Center providing two-way real-time operational data exchange such as cancellation information and NAS status.

Near Term: (2003-2005):

- As part of the CDM work plan, specific data elements will be identified and requirements defined to achieve this goal
- Develop a plan to transition and incorporate NAS status information into the CDMnet creating an open system architecture. Allow traffic flow management core technologies from which system Users can access data for development of decision support systems
- Develop a plan to ensure the incorporation of changing security standards
- Continued expansion and use of the diversion recovery tool (DRT)
- Continued proof of concept exploration of the pathfinder tool

Mid Term: (2006 –2009)

- Continued identification and dissemination of NAS status information through the appropriate infrastructure mechanism (for example, the CDMnet, FAA Internet, FAA Intranet). Mid term goals are dependent on the outcome of near term requirements and prioritization.

Long Term: (2010 –2013):

- Continued identification and dissemination of NAS status information through the appropriate infrastructure mechanism. Long term goals are dependent on the outcome of near term requirement and prioritization.

Information (Data) Collection and Communication Methods

<u>Traffic Management National Log (TMNL)</u>

The FAA's Traffic Management National Log (TMNL) is a FAA Air Traffic Services computer based communications and reporting system, accessible to Industry and Canadian ATC facilities. The TMNL enables controllers and traffic management personnel to record and distribute daily operational information with a single point of entry. TMNL will provide a more efficient method of capturing and disseminating information on restrictions (e.g., airport runway configuration changes can be entered and effected facilities addressed for notification). It will also identify capacity constraints regularly appearing in daily operations, allowing a greater focus towards mitigation.

Near Term (2003 – 2005)

- Continued expansion of the TMNL to all Air Route Traffic Control Centers (ARTCC)
- Identification of data connectivity requirements, including hardware requirements.
- Develop an implementation plan and timelines to extract restriction (MIT, ground stop and ground delay program) information from NTML into the CDMnet.

Mid Term (2006 –2009)

- Mid term dependent on near term requirement identification.

Long Term (2010 – 2013)

- Long term dependent on near term requirement identification.

Data Quality

The operational change expected through data quality enhancements will be improved predictability of the demand on NAS resources. Data quality spans a wide range of topics, notably for NAS predictions, flight plan intent information and accurate gate departure time have been identified as key data points that may produce the desired outcome.

Near Term: (2003-2005):

All NAS Users

- Create a tracking mechanism for identification and resolution of data quality issues
- Identify early intent flight plan data process
- Reduction of time-out cancellations impacts
- Reduction of "Pop-up" flights during ground delay programs

Scheduled Air Carriers

- Plan identification for use of flight times (Out Off On In (OOOI)

Other NAS users (general aviation)

- Identify and develop requirements for improvements in data quality

Mid Term: (2006 – 2009):

- Continuous improvement of data provided by the FAA and NAS users for enhanced collaboration.
- Develop single source processing for multiple traffic management systems, (ARTS, HOST, ETMS)
- Mid term is dependent on near term requirement identification.

Long Term: (2010-2013):

- Continuous improvement of data provided by the FAA and NAS users for enhanced collaboration.
- Long term is dependent on near term requirement identification.

Key Decisions

- Data quality standards adopted (e.g., timely cancellation notification that will allow maximum utilization of available airport capacity).
- Data sharing parameters adopted (e.g., inclusion of GA flight intent as early as possible).
- Common metrics identified for operational analysis and problem identification.
- Common goals and targets adopted to achieve a "System Thinking" approach.
- Identify the benefits of compliance and risk to non-compliance

Key Risks

- Access to data and information that is currently considered to be sensitive or company proprietary is at issue. There are security, company proprietary, and privacy restrictions on some of the information that has been requested for inclusion in the information exchange.
- The numbers of stakeholders (airspace users and FAA facilities) that need to be involved in the collaborative participation, due to incomplete intent data, the need for an agreed upon reduced en route capacity rationing process.
- Systems connectivity between stakeholders may not be fully established due to the diversity of stakeholder systems or operational environments. For example, major air carriers AOC fully connected to decision support tools through the CDMNet versus a single business jet operator whose preflight information comes from an Fixed Base Operator (FBO) or DUATS.

ER-2.2: Route Management (Improve coordination and implementation of alternative routes)

· Scope and Applicability

Current procedures require excessive coordination and time. Developing routings and entering amendments to flight plans impact system efficiency and create delays.
Managing system constraints, as well as, route management, is a collaborative effort between the FAA and Industry stakeholders to maximize system performance and capacity while ensuring safety of flight (i.e. relative to fuel, hazardous weather, volume, complexity, existing separation standards, etc.)

Goals to reduce route coordination time and enhance system efficiency through the creation of common situational awareness of potential route alternatives are:
1. Improve updating process for ARTCC facilities.
2. Incorporate graphic presentation and play book information
3. Implement and improve coordination procedures and route development options.

The ER-2.2 solution set, “Route Management” includes the following sub-groups:

2.2.1 Reroute Advisory Tool RAT
2.2.2 The National Playbook
2.2.3 Route Management Tool (RMT)/Coded Departure Routes (CDR)
2.2.4 Dynamic utilization of alternative routes through Military airspace
2.2.5 Dynamic utilization of alternative routes through Canadian airspace

2.2.1 Reroute Advisory Team (RAT)

Reroute Advisory Team (RAT) was formed with the task of improving the reroute advisories that are issued by the Command Center. The RAT thinking is that when the Command Center issues an advisory, it wants certain flights to be on certain routes, and the advisory should, therefore, be designed to maximize the chance that this will happen.

To achieve this, the RAT has set three goals:
1. To improve the language that is used in reroute advisories so that there is no ambiguity and so that all FAA and NAS user personnel can properly interpret these advisories.
2. To accompany each reroute advisory with a list of affected flights so that everyone will have a clear idea of which flights are relevant.
3. To provide this list of affected flights in a machine-readable form so those NAS users can deal with it efficiently. If these goals are achieved, advantages of decreased workload, increased speed of implementation, and improved compliance with the reroute advisories are expected

Near Term (2003-2005):

- Proof of concept exploration
- To improve the nomenclature used in reroute advisories to reduce ambiguity.
- To provide a relevant flight list accompanying each reroute advisory.
- To provide machine-readable flight list for automation efficiently.

Mid Term (2006- 2009)

- Mid term is dependent on near term successes

Long Term (2010 –2013)
Long term is dependent on near term successes.

2.2.2 The National Playbook (Playbook):

The National Playbook is collection a predefined, pre-coordinated alternative routes which reduces coordination/collaboration time and allows for a quicker response to changing NAS conditions.

Near Term: (2003-2005):

- Implement continuous improvement process for future development of the Playbook to include a tool integration plan.

Mid Term: (2006 – 2009):

- Playbook based automation procedures.(Specific tasks undefined)

Long Term: (2010-2013):
Undefined

2.2.3 Route Management Tool (RMT)/Coded Departure Routes (CDR) (RMT/CDR)

The CDR utility in RMT is a combination of coded air traffic routings and refined coordination procedures designed to mitigate the potential adverse impact of severe weather or other departure congestion events. RMT is a database query tool that allows users to view the centralized Coded Departure Routes (CDR) database and related tables from the National Flight Data Center (NFDC). Future versions of RMT will include other sources of routing information; for example, the National Playbook.

Near Term: (2003-2005):

- Continued refinement of the RMT

Mid Term: (2006 – 2009):
Undefined

Long Term: (2010-2013):
Undefined

2.2.3 Military Airspace: Dynamic utilization of alternative routes through Military airspace

Dynamic access to Military airspace along the Eastern Seaboard provides a valuable routing resource during severe weather events. The development of the VACAPE SWAP (VS) routes within the warning area airspace has provided an improved method to coordinate the release of needed airspace to provide a series of timely routing alternatives.

Near Term: (2003-2005):

- Continuous improvement of use and application of VS routes and dynamic usage of all military airspace
- Develop and implement transition routes to Florida destinations. (Once this is completed and

implemented we will have achieved our goal on the East Coast.

Mid Term: (2006 – 2009):
Not required

Long Term: (2010-2013):
Not required

2.2.4 Canadian Airspace Dynamic utilization of alternative routes through Canadian Airspace.

System constraints coupled with lack of available routes impact system efficiency and capacity. Canadian offload/severe weather routes are a series of RNAV routes that can be used during periods of domestic system constraint or as customer initiated routing alternative.

Near Term: (2003-2005):

- Increase efficiency and throughput of Canadian airspace by expanding automation compatibility between the United States and Canadian facilities.

Mid Term: (2006 – 2009):

- Increase efficiency and throughput of Canadian airspace by implementing automated hand-off automation compatibility between the United States and Canadian facilities.

Long Term: (2010-2013):

- Not required. We will have achieved our goal once automated flight plan processing and handoff capabilities have been implemented.

Key Decisions:

Key Risks:

- Limited availability of airspace in high volume situations that often occur in the Northeast during severe weather.
- Arrival and departure routing within terminal areas is limited by what can be accommodated adequately within prior environmental studies.
- Major additions to routes in terminal areas require design studies including environmental impact assessments.
- Dynamics of tactical real-time situations often require revision of pre-planned options.
- Improved coordination and communication when activating pre-planned options or changes to pre-planned options may require automation improvements to FAA/User systems.

ER-2.3: Technology: Improved Predictability of Congestion and Resolution Assessment

Scope and Applicability

The enhancements of existing decision support systems (DSS) and the addition of new DSS tools will improve the timeliness, accuracy, and quality of congestion predictions and resolutions. In the near, mid, and long term, continuous improvement programs will increase predictability of congestion and provide quality resolution assessment. These improvements in the information available to users and service providers are expected to result in better collaborative management of congestion. In particular, congestion management should become more pre-emptive and less reactive as these enhancements are implemented.
The ER-2.3 solution set, “Technology” will include the following sub-sets:

2.3.1 Existing Technology Improvements
2.3.2 Research and Development
2.3.2.1 Integrated Traffic Flow Management (ITFM)
2.3.2.2 Traffic Flow Management Modernization (TFM-M)
2.3.3 Systems Integration

2.3.1 Existing Technology Improvements

The Enhanced Traffic Flow Management System (ETMS) and the Flight Schedule Monitor (FSM) form the Traffic Flow Management Decision Support System Infrastructure. The Departure Spacing Program is a prototype system in use in the New York TRACON and Center. Improvements are planned for both the existing Infrastructure systems as well as in the functional capabilities.

- **Enhanced Traffic Management System (ETMS)**
  The ETMS is a network of processors and workstations used to track and predict traffic flows, analyze effects of ground delays or weather delays, evaluate alternative routing strategies, and plan flow patterns. It is a flight data processing and distribution system that utilizes historical flight routings, flight intent information, and actual aircraft position.
- **Traffic Situation Display (TSD)**
  The TSD is a sub-system of the ETMS. It provides NAS data, constraint information (monitor alert parameters (MAP), Flow Evaluation Area (FEA) and Flow Constrained Area (FCA), flight data, and composite weather radar to the ATCSCC, and field facilities.
  The FEA/FCA functions are available to Traffic Management Units (TMUs) on the Traffic Situation Displays (TSD). FCA’s provide identification of specific flights that will be affected by a NAS constraint and assist in developing traffic flow management alternatives. User access of TSD display information through the Common Constraint Situation Display (CCSD) will allow collaboration for identifying airspace constraints and routing solutions.

Near Term: (2003-2005):

- Continued refinement of Flow Evaluation Area (FEA)/ Flow Constraint Area (FCA) procedures through the CDM/CR FEA/FCA WG.

Mid Term: (2006 – 2009):

- Improve ETMS data for predictability in order to make better traffic management decisions, for example implement an early intent filing process (three to four hour pre-departure); see Data Quality, section 2.1.2.
- Playbook based automation procedures to support FCA/FEA solution alternatives

Long Term: (2010-2013):
Long term is dependant on success in the near and mid terms (Specific tasks undefined)

- **Flight Schedule Monitor (FSM) Enhancements**

The FAA Air Traffic Control System Command Center (ATCSCC) uses FSM for traffic flow management decision making by monitoring airports, viewing demand versus capacity and modeling ground delay programs and ground stops throughout the NAS. Flight Schedule Monitor (FSM) creates common situational awareness among the users, field facilities and the ATCSCC. Enhancements to FSM are continually being evaluated through the CDM arrival and departures (A and D) work group.

Near Term: (2003-2005):

- Proof of concept exploration, Human in the Loop (HITL) testing and prioritization of the following enhancements:
  • Distance based GDP's (additional HITL testing required)
  • Multi-airport GDPs (additional HITL testing required)
  • SCS (additional HITL testing required)

Mid Term: (2006 – 2009):

- Mid term is dependent on near term successes.
- Proof of concept exploration for
  • Multi-fix GDPs, (additional HITL testing required)
  • Playbook based GDP

Long Term: (2010-2013):

- Long term is dependent on near term successes.

- **Departure Spacing Program (DSP)**

  DSP assigns a departure time to achieve a constant flow of traffic over a common point. Runway and departure procedures must be considered for accurate projections.

  Near Term: (2003-2005):

  · Continued review of DSP use in New York Center (ZNY) and TRACON (N90)
  · Expand evaluation to the Boston (ZBW) and Washington (ZDC) Centers
  · Eliminate arbitrary and defensive MIT restrictions

  Mid Term: (2006 – 2009):
  Undefined
  Long Term: (2010-2013):
  Undefined

2.3.2 Research and Development:

Near Term Research (2003 – 2005)

Research Infrastructure

The current method for analyzing the operational maturity of proposed changes to the TFM systems relies heavily on live testing of new techniques, procedures and automation. Although successfully used in the past to develop and deploy beneficial capabilities to the NAS, CDM proposed concepts for managing en-route congestion are becoming significantly more complex and require a realistic simulation/test-bed environment before doing a live test.

Our collective ability to propose a suitable solution to congestion issues greatly depends on our ability to gather and analyze data in a post operational fashion. It also requires a deliberate departure from conventional methods of research that rely solely on the evolution of existing tools, pre-determined solution sets and anecdotal evidence. Therefore, we require an infrastructure to analyze performance data and trends to pinpoint specific problems.

1. We will deploy and support a suitable human in the loop (HITL) environment to provide a platform for the User and the FAA to refine CDM concepts in support of improved handling en-route congestion.
2. We will architect, archive, facilitate, share and consolidate to the extent possible TFM related data to aid our collective ability to define problems, provide metrics and establish performance parameters to expedite our research activities.
3. The recent creation of the TFM/DSP lab in the Tech Center will provide key insights.

TFM Decision Support Tools Research

- Irregular operations recovery focus tools
- Interactive TFM through improved insight into airport conditions and departure queuing, including departure flow management with respect to the en-route constraints.
- Improved system impact assessment capability to evaluate TFM strategies and monitor progress towards selected initiatives.
- Improved equity through common situation awareness, access to system constraint information and improved predictability in the system.

Mid to Long Term Research (2006 – 2013):

Although these research initiatives are deemed to be completed in the mid to longer term, it is expected that early findings can be incorporated within the existing TFM infrastructure in the near term.

Improved Strategic Planning Capacity

The current methods for assessing NAS system impact as a result of constraints such as weather and volume do not handle the uncertainty associated with their prediction. As a result, air traffic and dispatchers are limited in their abilities to properly strategize, collaborate and effectively mitigate the constraints.

We will perform research in the following areas to improve our collective ability to identify constraints in a timely fashion and establish suitable alternatives to react effectively to them.
1. Use of artificial intelligence, genetic algorithms and other techniques to identify congestion and deliver suitable strategies to avoid it.
2. Early intent information
3. Application of distributed command and control techniques.

Improved Execution of Flow Strategies

In some cases the existing flow of TFM related information is not reaching the appropriate decision maker in a timely manner to react effectively to planning initiatives. The existence of multiple standalone systems that support single decision treads is a source of workload and lost efficiency.

We will be performing research to discover where these gaps in the command and control structure currently exist. To accomplish this we will use the following approaches and techniques to identify, prioritize and propos the development of an appropriate solution:
1. Examine cross-domain (FOC, Enroute, TFM, Wx) data exchange requirements.
2. Define operational concepts for decision making to improve the dissemination and implementation of system wide strategic initiatives.

2.3.2.1 Integrated Traffic Flow Management (ITFM)

- CDM Integrated Traffic Flow Management
  The existing technology and procedures to manage en route demand during periods of constraint are inefficient. Developing integrated technology and procedures where dispatchers and system operators can file a flight plan querying the health of the NAS that will provide feedback on their route request and alternatives. Once they make decisions, they can lock in the routes thus providing a "carrot" for early intent filing and supporting our need for timely and accurate data.
  Goals to achieve this are:
  1. Develop global situational awareness.
  2. Develop interactive tools and methods to identify system constraints, alternatives and provide the user the opportunity to make economic decisions.
  3. Develop interactive tool based on timely and accurate flight plan data and system capacity that will allocate the available airspace resource in an efficient and equitable manner.
  4. The recent creation of the TFM/DSP lab in the Tech Center will provide key insights.

2.3.2.2 Traffic Flow Management Modernization (TFM-M)

The TFM automation infrastructure is the foundation for the decision support services that are provided by the TFM domain. A Flexible infrastructure is needed to support incorporation of the numerous products that are expected to mature from the Research and Development activities that are currently underway. If the infrastructure is not flexible, the time to incorporate the new capabilities will be much longer and there may be some capabilities that would be impossible to incorporate without a major, prohibitive change. The TFM-M program is planned to modernize the TFM automation infrastructure.

Near Term (2003 – 2005)

- Complete a TFM-M needs assessment review and develop a timeline for TFMM implementation.
- Establish requirements for the TFM-M
- Initiate a program for design and development of TFM-M
- Establish collaborative link to CDM ITFM team

Mid Term: (2006 – 2009):

- Complete the modernization based on the identified needs assessment developed during the near term.

· **Long Term: (2010-2013):**
Undefined

2.3.3 System Integration

Improved integration of existing data and decision support tools based on definition of desired operational concept and recommended requirements.

Near Term: (2003-2005):

- Identify the appropriate communication infrastructure to integrate NAS system information currently contained in closed system architecture into existing/enhanced CDMnet, for example, airport surface information currently being displayed in systems such as DSP.
- Enhance the CCSD mechanism to provide ETMS hub functionality.
- Conduct evaluations of existing tools
- Develop a concept of operations document
- Develop a requirements document
- Develop an integration plan by the end of 2003, which includes appropriate time windows

Mid Term: (2006 – 2009):

- Mid term dependent on near term developments

Long Term: (2010-2013):

- Mid term dependent on near term developments

Key Decisions

- Define collaborative processes and procedures for using FCA capabilities in ETMS.

Key Risk

- ·Investment on the part of the user community may be required for software integration with existing industry decision support and flight plan processing systems.

ER-2.4 Training: Expansion of Joint FAA/Airline Initial Training, Recurrent Training, and Analysis

Scope and Applicability

All participants in planning for traffic flow management (Users and FAA) need to have common training on Traffic Flow Management (TFM) techniques, procedures, and processes. The following programs have begun prior to the Spring 2001 convective weather season and will be on going as part of a continuous improvement process.

Near Term: (2003-2005):

Yearly

- Development of the training program for 2003 will build off the successes of an integrated training concept employing development and delivery consistent with the collaborative approach.

Mid Term: (2006 – 2009):
Yearly

Long Term: (2010-2013):
Yearly

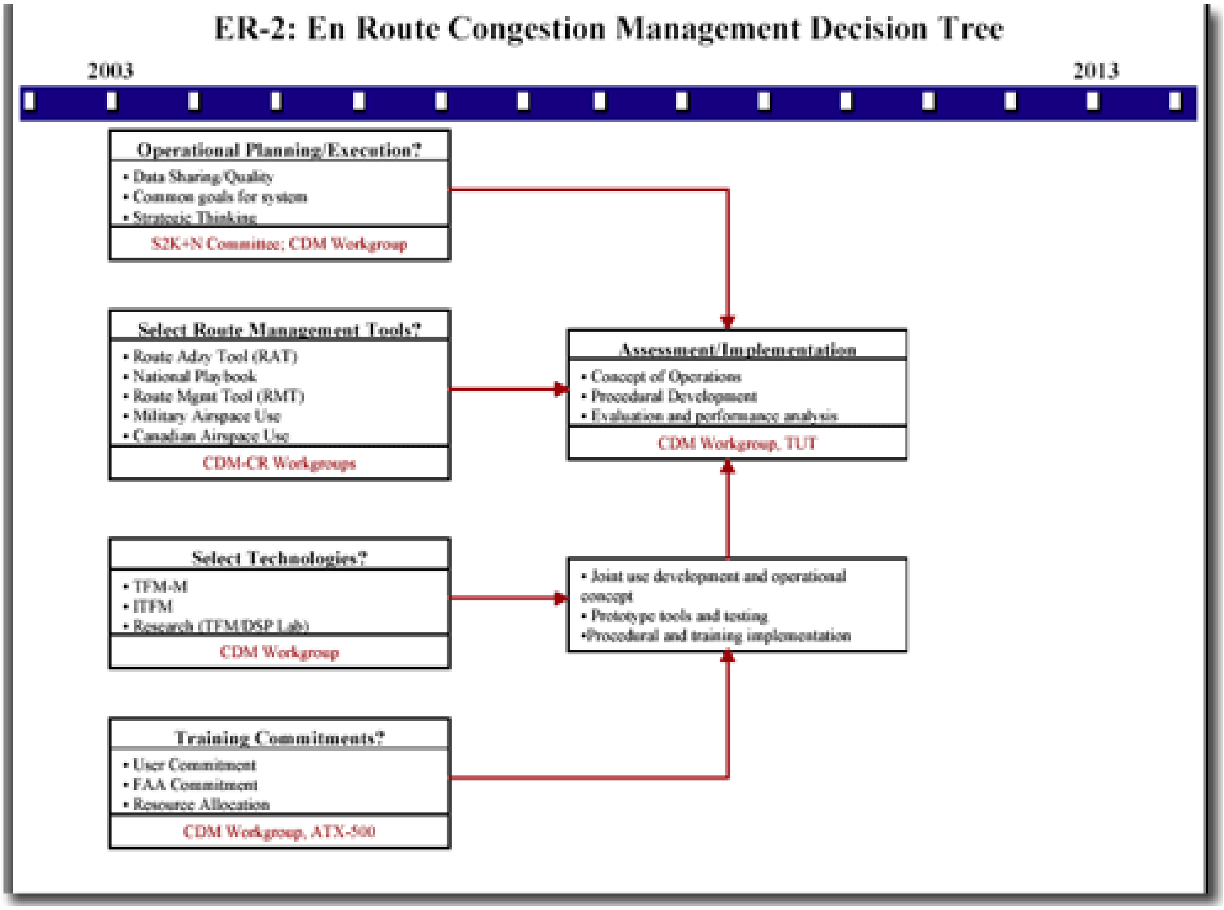
Key Decisions

- Providing resources and ensuring maximum participation for joint FAA/User training.
- Site availability for training due to security condition.

Key Risks

Resources, both internal and external to the FAA organizations

Decision Tree



[View enlarged decision tree]

Responsible Team

Primary Office of Delivery
Jack Kies, ATT-1

Support Offices
ATP-1
AOZ-1
AUA-700
ATX-500

Other Websites
[Relationship to the Architecture]

ER-3
Reduce Voice Communication

A significant portion of the controller workload is voice communications with the pilots. Application of selective communications services over controller-pilot data link communications reduces the use of en route voice communications. This change frees controller time and makes better use of the voice frequencies resulting in higher sector productivity, and an ability to accommodate the projected growth.

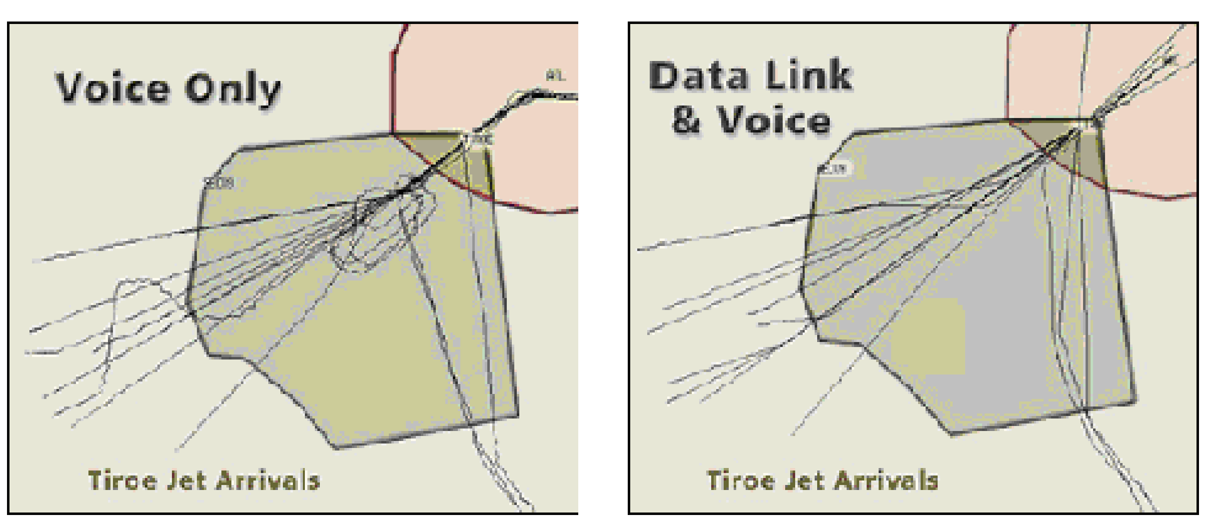
Key Activities:

CPDLC Build 1A National Deployment Plan	2004

Smart Sheet:
Version 5.0, December 2002

ER-1: Match Airspace Design to Demands

Reduce flow constraints by reducing voice communications workload.



Background

Pilots and radar controllers work together through voice communications to manage the flow of air traffic through the NAS in a safe and efficient manner. Structured sets of phrases have been developed for exchanging information and clearances, and for making requests. Standard phraseology is used to mitigate some of the limitations of oral communications. Communications between pilots and controllers often involve the exchange of routine information that is repeated for most aircraft entering or exiting a sector.

From a safety perspective, the primary sources of communication problems between controllers and pilots include: acoustic confusion; transposition of alphanumerics; “read-back” and “hear-back” errors; overlapping or simultaneous transmissions; misinterpretation caused by poor pronunciation; failure to use standard phraseology; manual data entry errors; and improper or malfunctioning radio keying operation. These communication failures contribute to a significant percentage of operational errors as well as reducing overall NAS efficiency.

As demand for access to the NAS increases, sectors shrink and the number of potential trajectory conflicts increase causing the controller-pilot communications burden to increase at a faster rate. In addition, the clearances needed for flexible routing, congestion management, and weather avoidance necessitate the exchange of complex route information between controllers and pilots not easily supported by oral communication. The provision of air traffic services via the use of data communications is a key means of addressing the safety, efficiency, and capacity constraints of the current voice communications-based NAS.

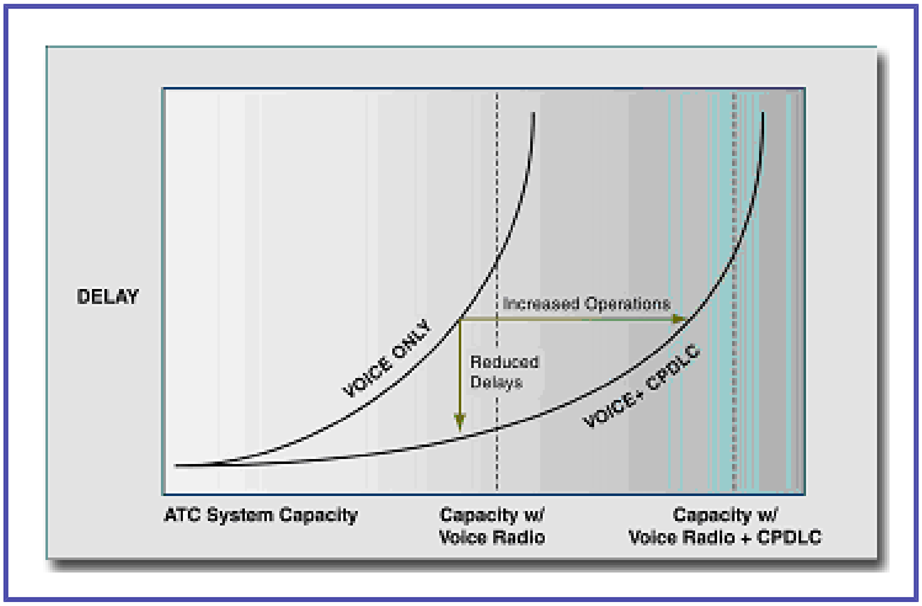
Ops Change Description

One of the key operational changes to reduce voice communication workload underway in the domestic en route environment is the use of the Aeronautical Data Link System (ADLS). ADLS has as its leading application Controller-Pilot Data Link Communications (CPDLC). CPDLC provides the capability to display air traffic communications exchanged between the controller and the flight deck, thereby reducing the dependence on voice communications. CPDLC, specifically Build 1, is also intended to serve as the lead application in the evaluation of the Aeronautical Telecommunication Network (ATN) architecture. Build 1 IDU occured on October 7, 2002, with a National Deployment Plan for an expanded CPDLC capability (Build 1A) expected during 2004. Future implementations of data link in En Route airspace (CPDLC Build 1A) will expand the services available with the following 9 services: Initial 4 Services from Build 1, plus, Assignment of Speeds, Headings, Altitudes, Pilot-initiated Altitude Requests, and Route Clearance Function. Within a short period after IDU for Build 1A we expect to add another downlink request, pilot-initiated route requests.

Benefit, Performance and Metrics

Reduced voice communications workload and distributed communications responsibility combine to provide the following benefits. Note that benefits increase as user equipage increases:

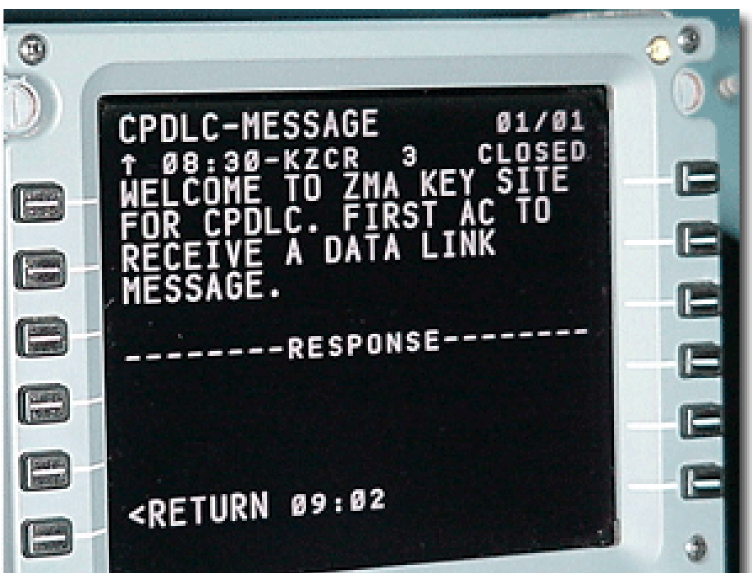
- Enhanced safety reflected by decreased operational errors and increased communications accuracy.
- Increased flight efficiency reflected by less time and fewer miles flown in sector (CPDLC reduces frequency congestion, therefore allows more timely and efficient delivery of clearances).
- Increased airspace capacity reflected by increased sector traffic throughput (miles in trail restrictions relaxed in an experimental sector based on voice communication reduction) and reduced delay (see chart below).



FAA, User Benefits of Two-Way Data Link Air Traffic Control Communications Aircraft Delay and Flight Efficiency in Congested En Route Airspace.
FAA, Benefits of Controller-Pilot Data Link ATC Communications in Terminal Airspace.

- As CPDLC evolves and is implemented nationwide, there are complimentary benefits to OEP objectives: ER-1, Matching Airspace Design to Demands; ER-4, Reducing Vertical Separation; ER-7, Accommodation of User Preferred Routing. These and any other objectives that may increase the need for communications within the NAS, will see their benefit increased with the availability of CPDLC.

Scope and Applicability



First CPDLC message sent from ground to aircraft

- CPDLC is intended for use in En Route airspace and requires a commercially provided digital air-ground infrastructure. Airspace users require proper equipage to use the service. TheFAA does not intend to mandate CPDLC equipage.
- Customer demand and equipage will drive service coverage and benefits.
- Initial data link (CPDLC Build I) will be evaluated at Miami Air Route Traffic Control Center (ARTCC) starting in 2002 with the following four services: Transfer of Communication, Initial Contact, Altimeter Setting, and Predefined Instructions via Menu Text.
- CPDLC Build 1A, the next implementation of data link in En Route airspace, will expand the services available with the following nine services: initial four services from Build 1, plus, Assignment of Speeds, Headings, Altitudes, Pilot-initiated Altitude Requests, and Route Clearance Function. Within a short period after IDU for Build 1A, we expect to add another downlink request, Pilot-initiated route request.

  Future implementations of CPDLC will bring expanding messaging capability, enhanced security features, and integration of CPDLC into the terminal and ground communication environments.

Key Dates

OT&E and SAT complete at ZMA	3/2002
First CPDLC message sent from ground to aircraft	3/2002
First American Airlines test flight w/ CPDLC ground system	4/2002
ZMA Airway Facilities training complete	6/2002
American Airlines B757 aircraft CPDLC Cert/Ops Approval	9/2002
American Airlines B767 aircraft CPLDC Cert/Ops Approval	10/2002
ZMA Air Traffic Controller training complete	9/2002
CPDLC Build 1 IDU at ZMA	10/2002
CPDLC Build 1A Deployment Plan	2004
CPDLC Build 1 Evaluation @ZMA	2002
CPDLC Build 1 IDU Decision	10/2002

Program Status

- Since March 2002, WJHTC aircraft have logged ~75 hours of flight testing with Rockwell Collins and ARINC AOA/ATN, with ~5,000 messages exchanged, ~ 50 hours of ground/airborne testing with Rockwell Collins and FAA CPDLC end systems, ~1,000 CPDLC messages exchanged.

- American Airlines (AAL) equipping B-767 and B-757 (16+) aircraft to participate in Build I operations in the Miami ARTCC.
- Commitment from Delta Air Lines and their avionics provider Teledyne Controls to participate in Build 1 operations in Miami ARTCC airspace. Revenue CPDLC flights scheduled to begin in early 2003. The United States Air Force has also committed to participation in CPDLC activities in 2003.
- Continental Airlines, and Fed Ex all currently have plans for equipping aircraft for CPDLC Build 1 operations in Miami.
- CPDLC Build 1A ground system level requirements have been baselined. The system design architecture proposed by the development contractor is currently under review by the FAA.

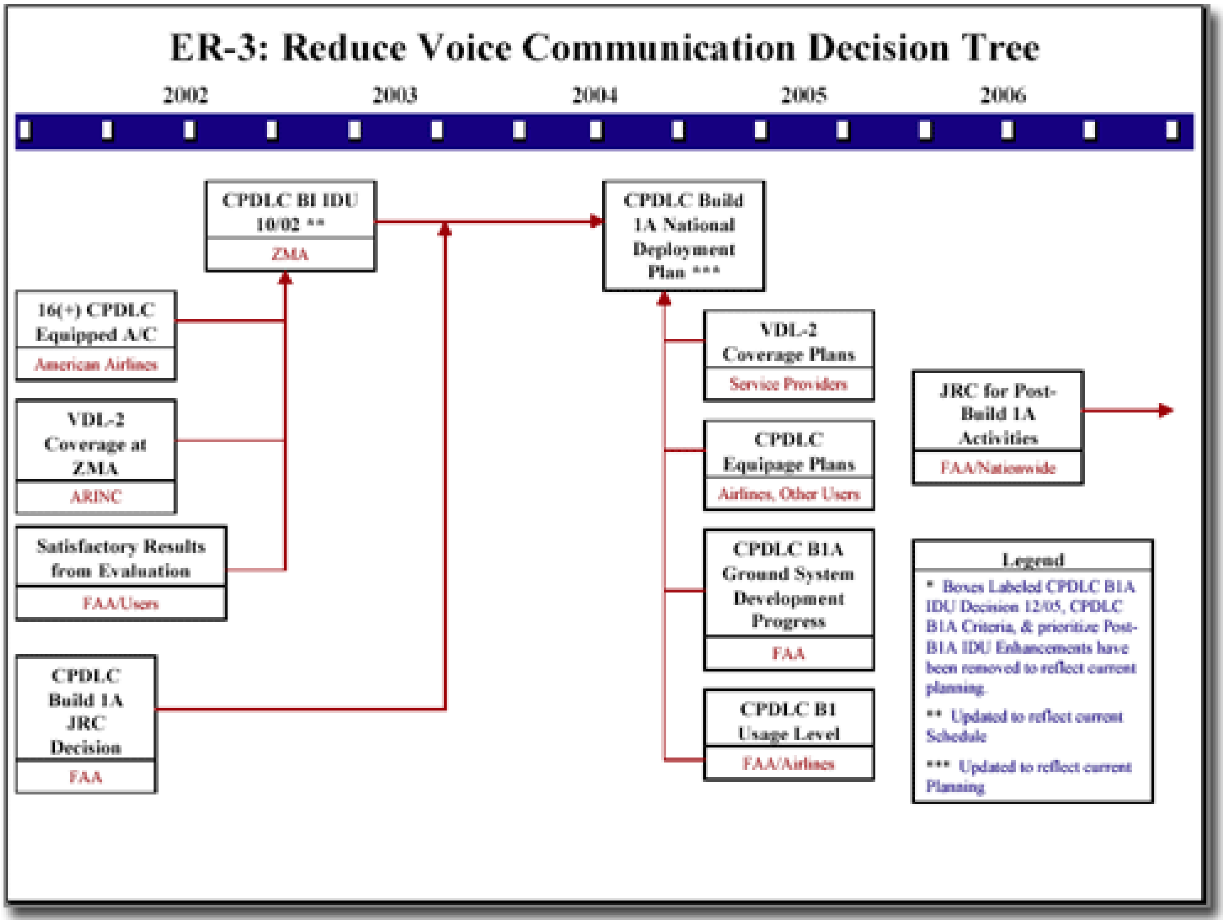
Key Decisions

- CPDLC National Deployment Plan. In 2004, the FAA will make the national deployment decision in collaboration with industry. Replanning is underway as a result of recent development issues and to factor the success of Build 1 in Miami into the decision. The decision will depend on CPDLC Build 1A development progress and a firm commitment/plan of equipage by the airlines. The FAA will not mandate equipage for CPDLC. Additionally, adequate coverage of the VDL-2 network will continue to be a factor.
- Post Build 1A Evolution. CPDLC activities beyond Build 1A are not funded until 2007. The program requirements, cost, benefits, and schedule will Be evaluated and baselined in 2005.

Key Risks

- System elements developed independently by stakeholders (e.g., FAA, ATN software vendors, avionics manufacturers, commercial communications service providers, and other air traffic service providers) must be interoperable.
- VDL-2 coverage of the NAS drives benefits. CPDLC communications will not be effective unless VDL-2 coverage is available across a significant portion of the NAS in order to make equipage cost-effective. If coverage is insufficient, users may not equip, controllers may not be able to use the capability fully, or FAA may not deploy to certain geographical areas.
- Experience is limited in the certification of cooperative air-ground systems. There is a need to acknowledge and credit the use of legacy and COTS systems and software in the end-to-end certification process. Furthermore, a change in the NAS automation architecture, e.g. Host to ERAM, could impact the certification level of CPDLC. A DO178B or DO278 treatment for design assurance for FAA ground systems will have a tremendously negative impact on the FAA’s ability to enhance its ground infrastructure and/or to spiral additional functionality for new air traffic tools. Use of DO178B or DO278 basically would freeze the infrastructure and/or capabilities in place; or, it would require the FAA to spend millions of additional dollars to move forward and to retain the current level of design assurance
- CPDLC represents a significant change in the human factors in the cockpit and the sector team and their interaction. This will require attention to ensure successful implementation. Increased planned prototyping and human-in-the-loop simulations at the early stages of the program will be designed to mitigate this risk.

Decision Tree



[View enlarged decision tree]

Responsible Team

Primary Office of Delivery
John Thornton , AOZ-1

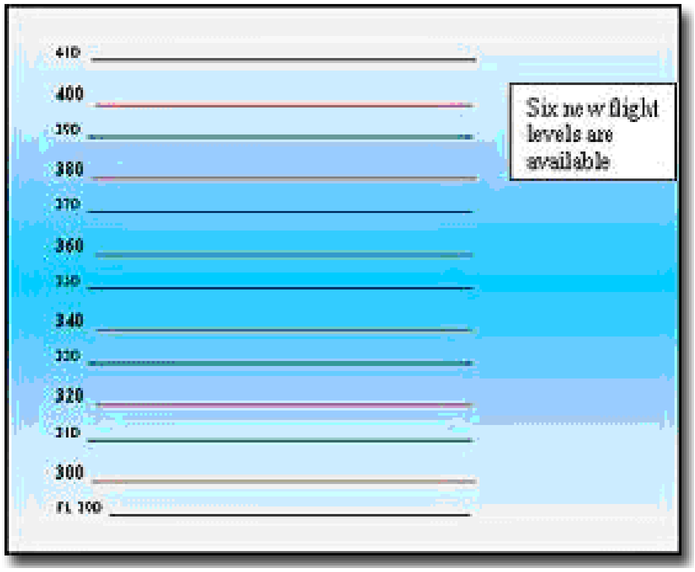
Support Offices
ATP-1
AUA-200
AIR-100

Working Forums
RTCA

Other Websites
[Relationship to the Architecture]
ER-3 Links To Architecture
Air Traffic Services / ATC-Separation Assurance / Aircraft to Aircraft Separation Capability
102113 - Reduced Routine Workload And Increase Efficiency By Improved Messaging - Demonstration
102114 - Reduced Routine Workload And Increase Efficiency By Improved Messaging - National
102115 - Increased Flexibility And Safety - Strategic Messaging

RTCA Website
Free Flight Program Office

ER-4
Reduce Vertical Separation



Implementation of the Reduced Vertical Separation Minimum (RVSM) between 29,000 and 41,000 feet (flight levels FL 290 and FL 410) will add six additional flight levels. This will provide benefits to the users and Air Traffic Control. Effectively reducing delays and contributing to time and fuel savings for the vast majority of users. In addition not only will this relieve enroute capacity constraints for the present, but for the medium to long term planning.

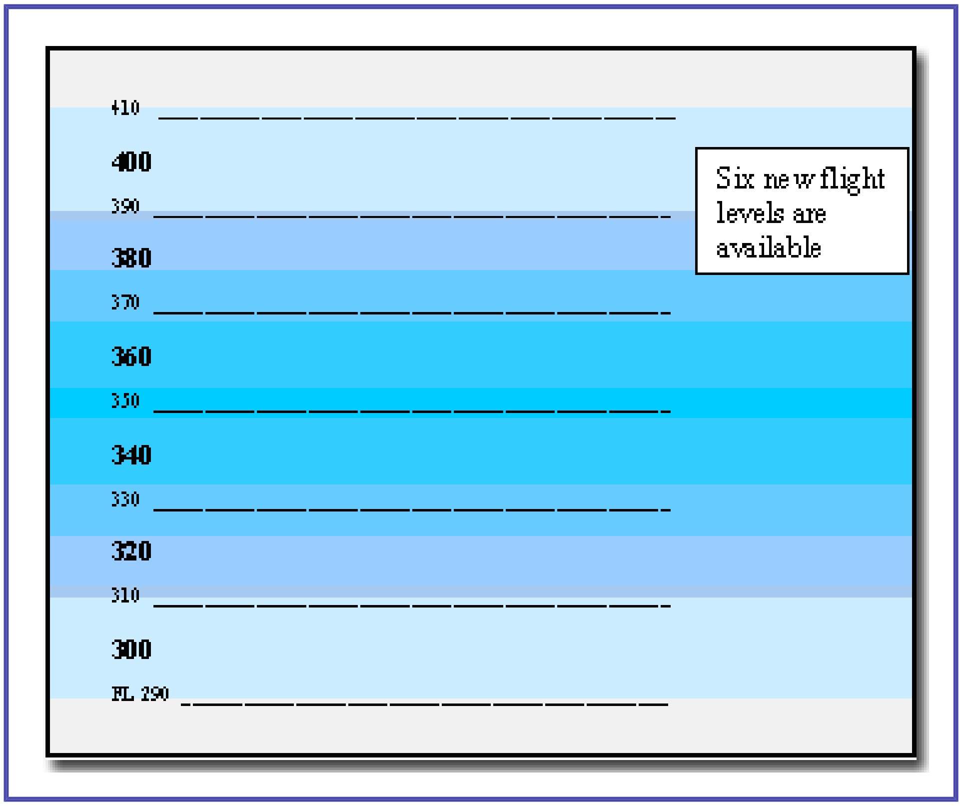
Key Activities:

Publish Final rule	June 03
Deploy monitoring systems to assess aircraft altitude keeping performance	June 03
Safety analysis review	June 04
NAS Automation modifications complete	December 03
Track fleet readiness in Database against implementation goals	January 05
Proposed Implementation FL290-410	January 05

Smart Sheet:
Version 5.0, December 2002

ER-4: Reduce Vertical Separation 11/402 Update

Reduce vertical separation minima to 1,000 feet for flights operating between 29,000 feet and 41,000 feet.



Background

In US domestic airspace 1,000 foot vertical separation is applied up to FL 290 and 2,000 foot vertical separation is applied above FL 290. The Reduced Vertical Separation Minimum (RVSM) program allows 1,000 foot vertical separation to be applied between FL 290 – 410 (inclusive). RVSM was initially implemented in the North Atlantic (NAT) between FL 330-370 in March 1997. It was implemented in Pacific oceanic airspace between FL 290-390 (inclusive) in February 2000. RVSM is now implemented in the NAT, Europe, the New York Oceanic FIR portion of the West Atlantic Routes System and Australia between FL 290-410 (inclusive). (A map showing RVSM implementation status in individual areas of the world can be viewed on the FAA RVSM website discussed below).

Aircraft that have complied with FAA RVSM standards are eligible to conduct RVSM operations worldwide with the exception that if a single altimetry system is adopted, those aircraft will be restricted to U.S. domestic airspace. The operator, however, must adopt operational policies/procedures specific to individual areas of operation prior to commencing RVSM operations in those areas. Approximately 30% of aircraft that operate in the US above flight level 290 were RVSM compliant as of August 2002.

The FAA maintains an RVSM website at www.faa.gov/ats/ato/rvsm1.htm. Specific information on FAA RVSM policy/procedures for aircraft and operator approval, air traffic control and monitoring can be found on that website.

Ops Change Description

The objective is to implement RVSM in the vertical stratum of the airspace of the contiguous 48 States of the United States and Alaska and in Gulf of Mexico airspace where the FAA provides air traffic services (Houston and Miami Oceanic Flight Information Regions and Jacksonville Offshore Airspace).

Benefits, Performance and Metrics

- *Fuel Burn Savings*. Fuel burn savings are projected to be approximately $5.8 billion over the 15 year period between 2004-2018. Fuel burn savings are estimated to be $371 million in the first year increasing at a rate of 1.5% per year. This amounts to an approximately 2% per cent savings for US domestic operations. Fuel burn savings are directly attributable to greatly improved performance of jet engines above FL 290, as well as improved routing, altitude selection, and reduction of delays provided by RVSM
- *Increased Flight Level Availability*. Makes six additional flight levels (for a total of 13) available for operations between FL 290-410. (Current FL orientation schemes applied between FL 290-410 provide seven useable FL's).
- *Airspace Capacity*. Provides potential increase in sector capacity by enhancing traffic throughput and efficiency within en route airspace.
- *Controller Flexibility*. Enhances controller flexibility. Provides more options for situations such as weather re-routes and crossing traffic.
- *Controller Workload*. Reduces controller work load.
- *Conflict Points*. Diminishes the effect of traffic converging at critical points in high density traffic areas.
- *Enhanced Predictability*. Enhances predictability of operations by increasing the flight levels available to move aircraft allowing more aircraft to fly at requested flight level.
- *Delays*. Provides potential to reduce departure delays.

Scope and Applicability

The Domestic Reduced Vertical Separation Minimum (DRVSM) Team has held meetings with user advocate groups and DoD. Such meetings will continue to be scheduled periodically to inform and obtain feedback from users. Also, RVSM seminars are being held to educate users and FAA field offices on RVSM program requirements. (See the FAA RVSM website for seminar announcements and schedule).

- The proposal to implement RVSM between FL 290 - 410 (inclusive) on January 20, 2005 is considered to be a feasible option and the FAA is developing its plans accordingly.

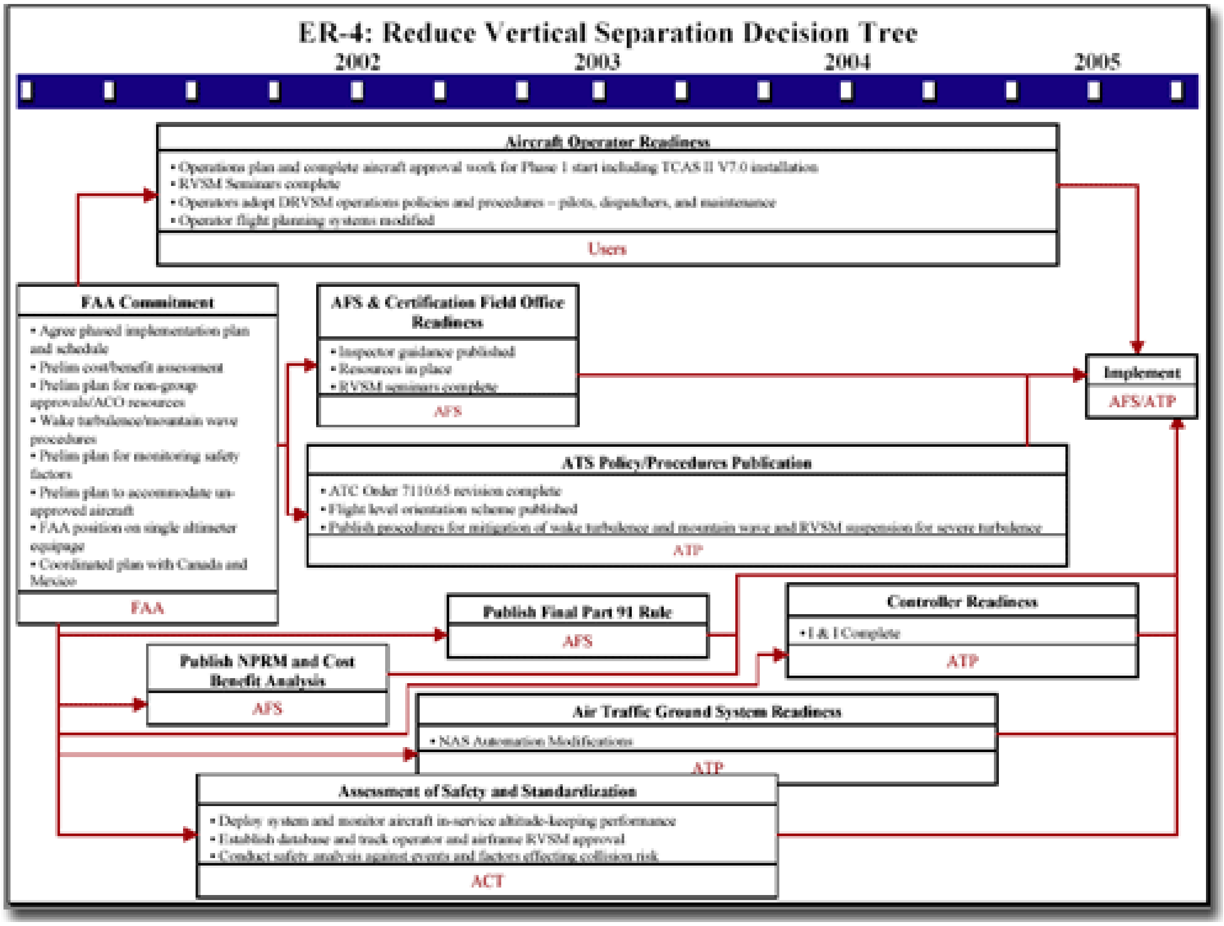
Key Decisions

- Implementation dates and vertical stratum.
- Policy has been established for non-RVSM compliant DoD and air ambulance aircraft.
- Key Tasks and Risks
    - RISKS
        - *Cost/Benefit and Implementation Schedule*. General user acceptance of an implementation plan and schedule that enables the significant majority of aircraft to be engineered to RVSM compliance. (ATP, AFS)
        - *Operator Fleet Readiness*. Operators must complete required aircraft and operator approval actions in the period leading up to implementation (AFS,

AIR).Failure of Operators to accomplish these actions by a significant number could result in program delay.

- TASKs
  - Implementation of procedures to transition non-RVSM aircraft to climb and descend through RVSM airspace to operate at and above FL430. Rulemaking. FAA published an NPRM in May. The 90-day comment period ended on August 8. The Final Rule is scheduled for publication in June 2003.
  - *Accommodation of Un-Approved Aircraft*. Acceptance of policies for accommodation of non-RVSM approved DoD and air ambulance aircraft (ATP, AFS).
  - *Wake Turbulence/Mountain Wave Effects*. Development of procedures to mitigate the effect of wake turbulence and mountain wave effect (ATP, AFS).
  - *Flight Standards Field Resources*. Development of plans for Flight Standards field office approval of large numbers of aircraft and operators (AFS).
  - *Aircraft Certification Office Resources*. Development of plans for Aircraft Certification Office resources to approve individual unique (non-group) airframes for RVSM (AIR, AFS). *Note*: We have established a memorandum of understanding with DoD to accomodate their aircraft in domestic US RVSM airspace.
  - *Coordination with other Air Traffic Service providers*. Coordination of implementation plan with Canada, Mexico and ATS providers in the Caribbean and South America. (ATP, AFS, ACT).
  - *Safety Analysis*. Acceptability of safety analysis to support the DRVSM implementation decision (ATP, AFS, ACT).
  - *TCAS Version 7.0*. Aircraft equipped with TCAS II and used in RVSM operations will be required to equip with, Version 7.0 (or a later version) in accordance with part 91 Appendix G. (TCAS equipage is not required for RVSM operations. TCAS equipage requirements are published in regulations not related to RVSM).
  - *NAS Modification*. Modify NAS capabilities such as conflict alert to make them effective at FL's above 290 where 1,000 ft vertical separation is applied. (ATP).
  - *Pre and Post Implementation Monitoring*. Pre- and post implementation monitoring program to assess key factors related to operational safety: data base of approved operators/aircraft; system to monitor aircraft altitude-keeping performance (AFS, ACT).
  - *Airspace Re-Design*. Coordinate DRVSM program with High Altitude Airspace Re-design Program (ATP, ATA).

Decision Tree



[View enlarged decision tree]

Responsible Team

Primary Office of Delivery
James L. Ballough, AFS-1
Robert Swain, AFS-400
Lead Specialist: Flight Technologies and
Procedures Division

Support Offices
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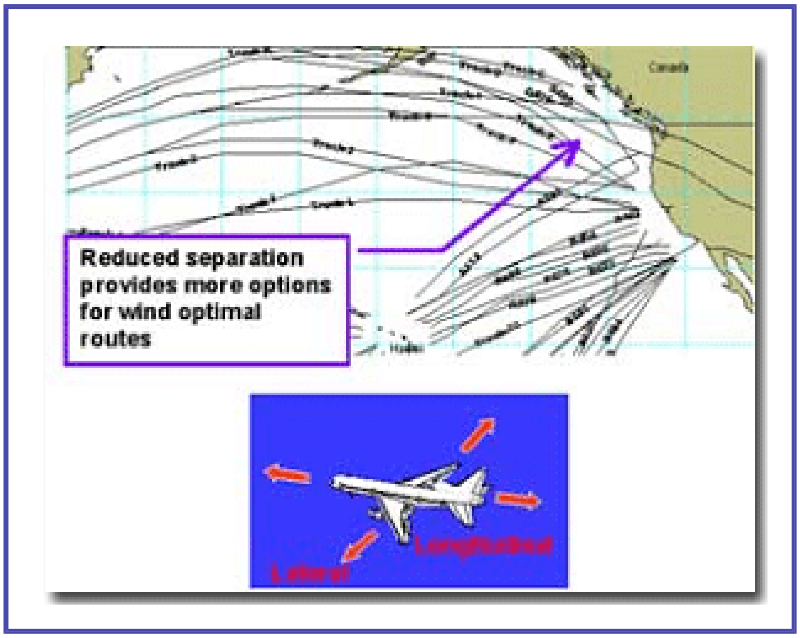
Enroute Operations / Procedures: ATP-110
NAS & International Airspace Analysis
Branch: ACT-520
Automation: AUA-200

Working Forums

Other Websites
[Relationship to the Architecture]

ER-6

Reduce Oceanic Separation



Transoceanic flights are confined to airspace based on separation standards that are defined for manual surveillance and unreliable communications. Allowing properly equipped aircraft to operate at reduced oceanic separation will enable more aircraft to fly optimal routes, enhancing aircraft time efficiency in the oceanic leg of their flight. Reduced separation laterally may provide space for additional routes to current destinations or new direct markets. Reduced longitudinal (nose-to-tail) separation will provide more opportunity to add flights without a delay or speed penalty.

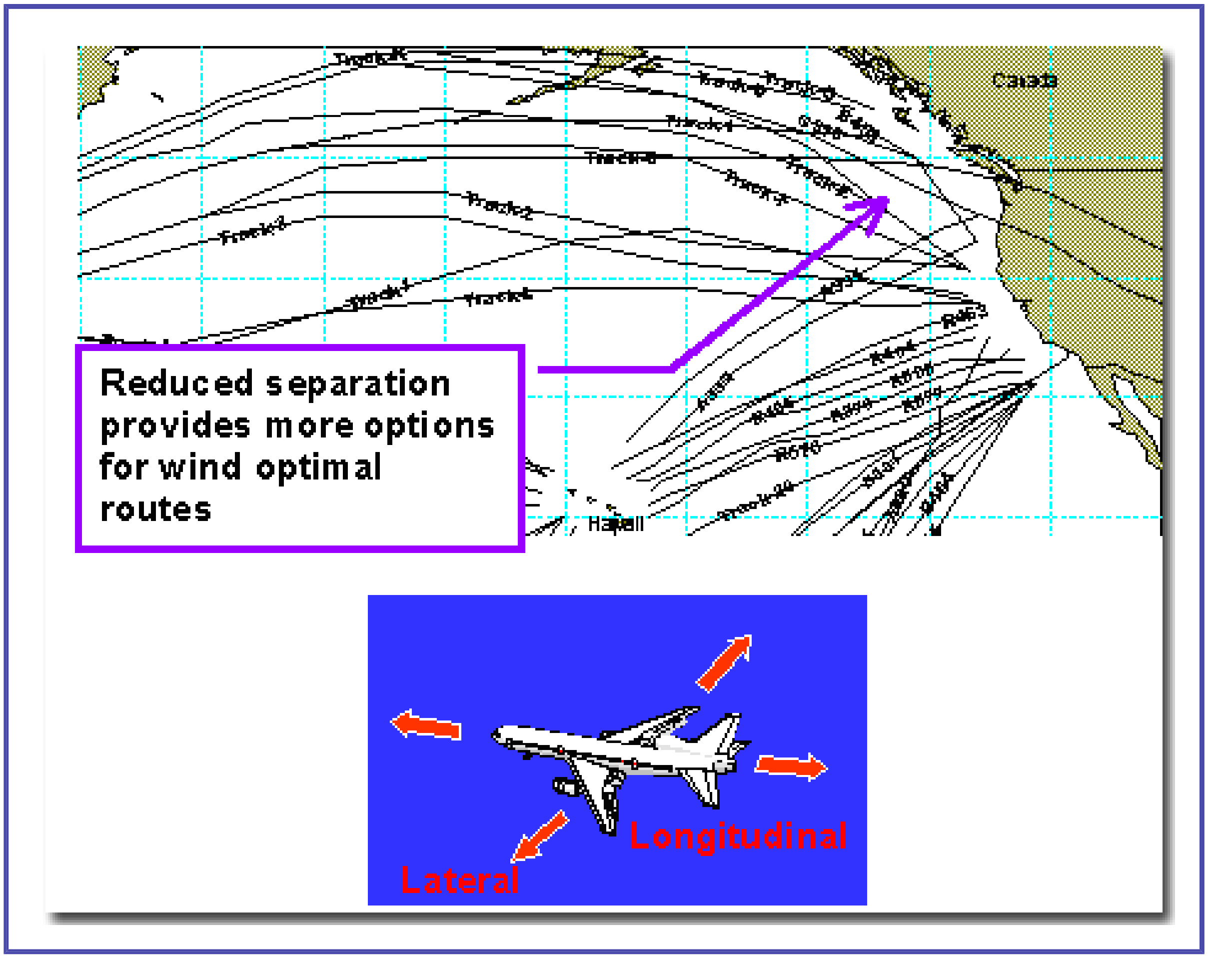
Key Activities:

ATOP IOC at Oakland	4/03
ICAO Regional Procedures and Guidance	11/03
ATOP Build II at Oakland	11/04

Smart Sheet:
Version 5.0, December 2002

ER-6: Reduce Oceanic Separation

30 nm lateral and longitudinal (30/30) separation in the ocean.



Background

- *Separation Standards Factors*. Separation standards in a given airspace are a function of the communication, navigation, and surveillance capabilities available in a specific operating environment. Safety analysis and operational judgment consider factors such as: timeliness and reliability of controller-pilot communications, accuracy of aircraft navigation, the controller's ability to determine potential separation loss, aircraft traffic density, and procedures for contingencies such as engine failure and weather deviations.
- *RNP Concept*. The Required Navigation Performance (RNP) concept has been introduced in Pacific operations to standardize navigation. For example, RNP-10 approved aircraft are equipped with navigation systems that can navigate within 10 miles of desired position with 95% probability.
- *Current Separation Standards*. Currently, the minimum lateral separation applied by the FAA is: 120 nm in Atlantic and Caribbean/South American airspace, 60 nm in North Atlantic minimum navigation performance specification airspace, 50 nm between RNP-10 approved aircraft in Pacific airspace except in the Central Pacific where, due to convective weather, 100 nm lateral is applied south of 30N.
Conventional longitudinal separation is 10 minutes (approximately 80 nm). 50 nm longitudinal separation is currently applied by South Pacific air traffic service providers having enhanced CNS/ATM systems, to aircraft approved for direct controller-pilot communication via voice or data link and RNP-10 (10 nm/95% probability). In the FAA's oceanic airspace, communication service is currently a FANS 1/A system.
- *Current Deployment of ADS-A Systems*. Air Traffic Service Providers in New Zealand, Australia, Tahiti, and Fiji use FANS 1/A Automatic Dependent Surveillance-Address (ADS-A)

systems in Pacific oceanic airspace. In addition, a similar system is under operational testing in Tokyo oceanic airspace.

- *Status of Aircraft System Approvals*. The FAA and other civil aviation authorities have certified ADS-A, CPDLC and RNP capabilities on aircraft such as the B-747-400, B-777 and the A-340.

Ops Change Description

30/30 Separation. The ICAO Separation and Airspace Safety Panel has established standards for the implementation of 30 nm lateral and longitudinal separation that call for: direct controller-pilot communication via voice or datalink, aircraft navigation accuracy to RNP-4 (4 nm/95% probability) and ADS-A capability in the aircraft and at the oceanic center.

FAA ADS-A/ATOP Program. The Advanced Technology and Oceanic Procedures (ATOP) program will deploy ADS-A capability in airspace where the FAA provides oceanic air traffic services. FAA oceanic centers currently offer direct controller-pilot communication via data link + to equipped aircraft.

The ATOP system will enable the application (to properly equipped aircraft) of 50 nm longitudinal separation (extended use) and 30 nm lateral and longitudinal separation. These reduced separation standards will increase oceanic airspace capacity and aircraft time/fuel burn efficiency. ATOP will also improve the safety of oceanic operations by giving controllers enhanced tools to track aircraft progress and identify potential aircraft conflicts and problems.

Benefits, Performance and Metrics

- *Fuel/Time Savings.* Provides equipped users with fuel and time savings, more reliable and optimum routes and greater likelihood of timely granting of requests for clearance changes.
- *Flown as Filed.* Percentage of flights cleared as filed will increase. As a result, fewer altitude change or speed commands are needed because of the pilot’s ability to maintain spacing and the smaller separation “bubble” required around each aircraft.
- *Route Efficiency*. The number of routes moved closer to great circle or minimal wind route is expected to increase, resulting in the reduction of fuel load as route reliability increases.
- *Step Climbs*. Increase in user requests granted for procedures such as step climbs.
- *Safety Benefit/Collision Risk Reduction.* Enhanced ATOP surveillance capabilities combined with direct controller-pilot communication via voice or data link will enable controllers to detect and intervene when aircraft deviate from cleared track or altitude and mitigate the risk of conflict with other aircraft.

Scope and Applicability

- *Enhanced Surveillance in FAA Controlled Oceanic Airspace*. ADS-A will provide enhanced surveillance capability in Oakland, Anchorage, and New York oceanic airspace. ADS-A will enable the FAA to apply 30 nm lateral and longitudinal separation in that airspace.
- *Initial Goals/Dates*. Initial FAA goals are to implement 30 nm lateral and longitudinal (30/30) separation in Oakland controlled South Pacific airspace by 2005.
- *Medium to Long Term*. As ADS-A deployment progresses and as more aircraft become RNP-4 capable and approved, use of 30/30 separation will be expanded beyond the South Pacific. In

the period 2006-2013 it is expected that 30/30 will be utilized throughout the Pacific and potentially in the North Atlantic airspace controlled by New York ARTCC.

- *Aircraft Fleet Equipage*. 30/30 separation and enhanced surveillance will only apply to appropriately equipped aircraft. Aircraft system requirements for 30/30 include direct controller-pilot communication via voice or data link, RNP-4 approval, and ADS-A.
- *Contingency Procedures*. Contingency procedures will be developed for loss of communications, ADS-A or aircraft RNP-4 capability, aircraft system malfunctions, and weather deviations.

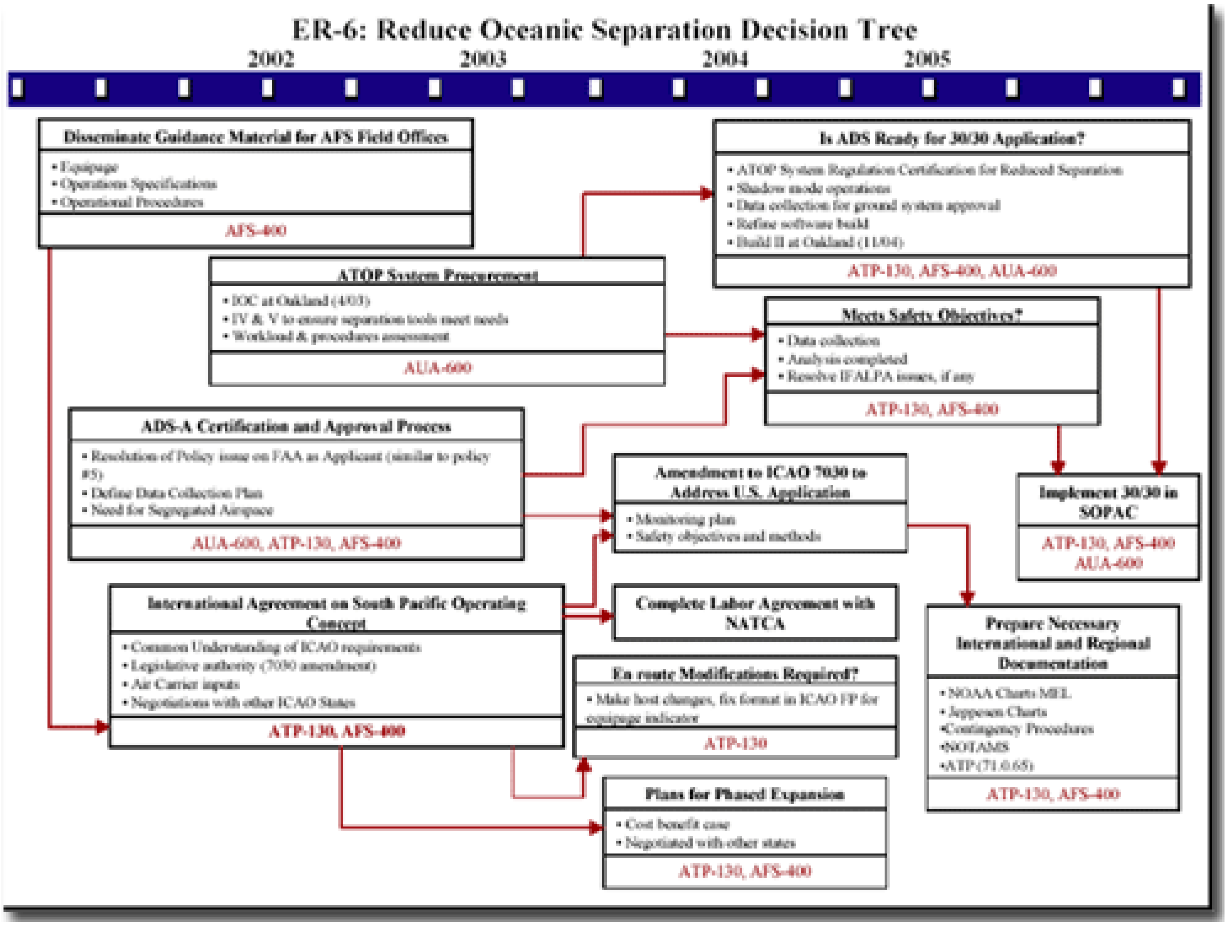
Key Decisions

- *Cost/Safety Benefits*. Operator decision to increase levels of aircraft equipage, based on cost/benefit and safety enhancements gained by ATOP deployment.
- *Aircraft Fleet Equipage*. To maximize benefits, aircraft fleet equipage with direct controller-pilot communication via voice or data link, RNP-4 and ADS-A capabilities must increase significantly. (Currently approximately 30% of oceanic flights are so equipped.)
- *Accommodation of Mixed Equipage time*. Decision on how to accommodate aircraft with mixed CNS capabilities for an extended period of time must be developed and accepted.

Key Risks

- *ADS-A System Deployment*. ADS-A system must progress without significant delay to IOC and Build II at Oakland ARTCC.
- *ADS-A System Performance*. ADS-A system must perform at prescribed levels of reliability and availability
- *ATOP Deployment*. ATOP must be deployed on time.
- *Staff Resources*. Adequate experience and staffing levels to support national and local procedures development, operator approval, and transition of systems for the separation standards in ocean and remote areas.
- *AFS Resources*. Availability of Flight Standards specialist resource to assess ADS-A system performance and capability to mitigate collision risk and enable aircraft separation reduction.
- *30/30 Implementation Requirements*. Acceptance of adequacy of 30/30 implementation requirements such as safety analysis, ground and aircraft capabilities, and contingency procedures.
- *Operator Commitment to Aircraft Equipage*. Cost/ benefit and safety analysis to advocate fleet advanced CNS equipage beyond current approximate 30% level.
- *Revision of ICAO Regional Policy Documents*. Publication of 30 nm lateral and longitudinal standards in ICAO Asia and Pacific Regional Supplementary Procedures.

Decision Tree



[View enlarged decision tree]

Responsible Team

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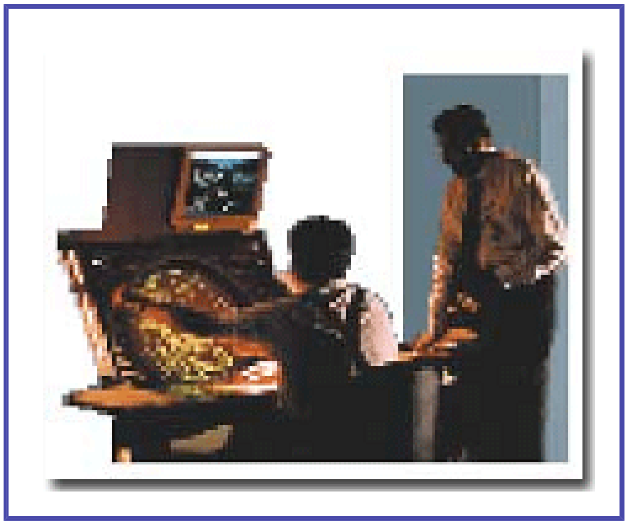
Working Forums
Oceanic Separation Reduction Work Group

Other Websites
[Relationship to the Architecture]
http://www.faa.gov/ats/ato/130.htm

ER-7
Accommodate User Preferred Routing



Today, controllers have a view of the airspace that is bounded by the sector that they control. Fixed airspace structures used to organize flows and create predictable intersections are necessary for moment-to-moment control. These structural limitations in some cases result in under utilization of some airspace even as adjacent airspace may be congested. A more strategic look across multiple sectors with conflict detection tools and the flexibility granted the users in the national route program should decrease the concentration of flights. However, in some cases the structure may actually enhance the efficient use of airspace. A careful balance of sufficient, predictable flows and controller look-ahead is required to ensure that flexibility does not simply shift the point of congestion to other sectors.

Key Activities:

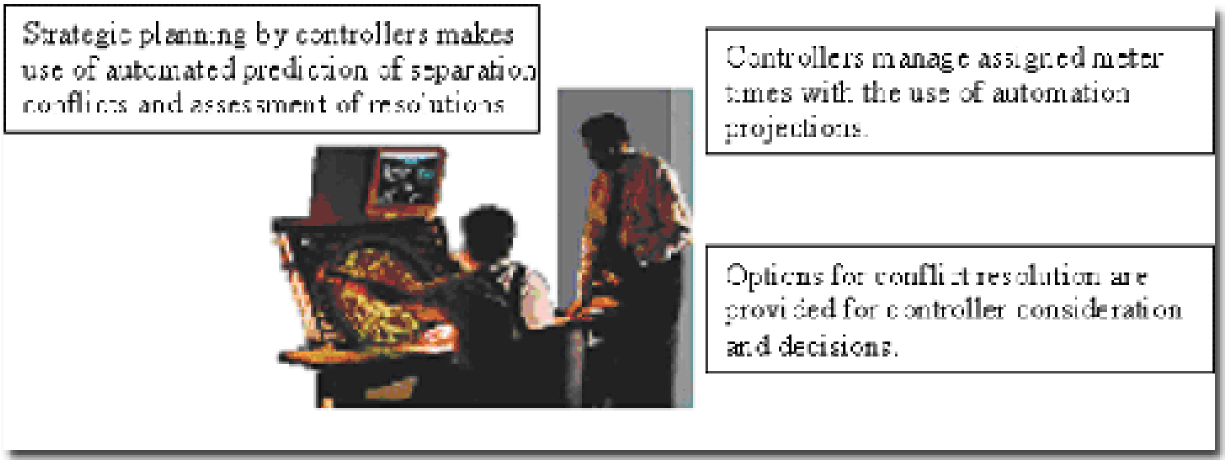
Deployed URET at Six FFP1 Sites	2002*
Comprehensive Revisions to Restrictions (Ongoing)	2003
Deploy URET to 4 additional sites	2003
Evaluate PARR	2004
Evaluate D2	2004
Deploy URET to the 10 remaining sites	2004**
Evaluate EDA	2005

*URET deployed at ZTL during FFP!; however, a local staffing issue has kept it from going operational (IDU).

Smart Sheet:
Version 5.0, December 2002

ER-7: Accommodate User Preferred Routing

Optimize airspace use by providing decision support tools to users and service providers.



Background

Today, controllers have a view of the airspace that is bounded by the sectors for which they have jurisdiction. This view limits the options available to the controller to solve problems. In addition, a fixed route structure is used to organize the airspace, providing controllers with predictable points where conflicts may arise. This fixed route structure allows controllers to maintain a three-dimensional view of the traffic situation. In some cases, however, this results in aircraft being separated from airspace. In the current environment, flow constraints (e.g., Miles-in-Trail restrictions, ground delay programs, re-routes) are used to avoid situations where the number of aircraft being controlled by an en route sector controller is beyond the controller's ability to provide separation services. This also results in the users being constrained in their choice of flight paths.

Ops Change Description

By providing Air Traffic Management decision support capabilities to the sector, controllers are able to see beyond their own sector boundaries allowing some long standing restrictions to be removed, increasing the options to solve problems as well as increasing the likelihood that more efficient services can be provided. This will be accomplished through the addition of strategic management tools that complement the tactical control techniques used to maintain safety. These strategic tools provide advisory information about routes and/or altitude options that can avoid conflicts and weather situations. The specific decision support capabilities are:

- ER-7.1: *Conflict Identification and Planning*, which assists controllers in the prediction of aircraft-aircraft and aircraft-airspace conflicts and which has capabilities for controllers to construct and assess alternatives. The User Request Evaluation Tool (URET), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities.
- ER-7.2: *Metering and Merge Planning*, which provides a metering plan to TMCs and provides information to controllers to quantify the differences between assigned meter times and the times that aircraft are projected to cross a meter fix. The Traffic Management Advisor (TMA), being developed and deployed under Free Flight Phase 1 and 2, will provide these capabilities at some locations. An enhanced version of TMA, to optimize arrival traffic management spanning multiple ARTCCs is currently in research. Although TMA is cited also under AD-4, it is included here to emphasize its role in optimizing airspace utilization.
- ER-7.3: *Conflict Resolution and Planning Aids*, which are used by controllers to generate proposed solutions to aircraft-aircraft and aircraft-airspace conflicts and to identify instances where a more direct route will result in user savings. A resolution capability - Problem Analysis, Resolution, and Ranking (PARR) and a direct routing aid - Direct-to (D2) are

currently being researched. D2 is also conflict detection and conflict resolution.
From the user perspective these capabilities will support their ability to fly routes that are defined by points in the airspace (latitude/longitude/altitude), with fewer restrictions caused by the structure of the airspace.

Benefit, Performance and Metrics

- Reduction in static airspace restrictions (ER-7.1 and ER-7.3).
- The total miles flown through a center will decrease (ER-7.1 and ER-7.3).
- Hourly flow by ARTCC and Sector will be increased (ER-7.1 and ER-7.3).
- Fewer low-altitude holds will be invoked (ER-7.2).
- Fly as filed percentage (including altitude) will increase (ER-7.1 and ER-7.3).
- User-requested re-route percentage being granted will increase (ER-7.1 and ER-7.3).
- Airport peak operations rate will increase (ER-7.2).
- Reduction in departure delay for flights released by the ARTCC (ER-7.1, ER-7.2, and ER-7.3).
- More efficient delay distribution in transition airspace (ER-7.2).

ER-7.1 Conflict Identification and Planning

Decision support tools assist the controller in detecting conflicts and assessing potential changes to the aircraft's path. Enhancements to Conflict Detection are being addressed by D2 research as well.

Scope and Applicability

- URET can be applied to all en route airspace. The benefits URET provides depend on the traffic levels and complexity that sector controllers have to deal with. For greatest benefit, URET should be available in contiguous airspace.
- URET CCLD is deployed and operational at six centers (Cleveland, Chicago, Memphis, Indinapolis, Kansas City, and Washington). Phase 1 URET deployment is complete.
- Next Step: FFP will expand URET to Minneapolis, Denver, Albuquerque, Fort Worth, Jacksonville, New York, Houston, Atlanta, Boston, Miami, Salt Lake City, Seattle, Oakland and Los Angeles centers. The FF Program Office will complete deployments prior to 2005, with initial daily use at four sites in FY 03 and ten sites in FY 04. URET will initiate efforts for integration with CPDLC.
- URET will be deployed nationally starting in FY03 without the Assisted Trial Planning-Coded Menus functionality. Assisted trial planning is a PARR research function and will be implemented in URET at the earliest in URET Build 4 in late FY04 or early FY05 if the function is prioritized by AT as a candidate for Build 4. If not, it would not be implemented until URET Build 5 in FY05 or later.

·Key Decisions

None identified.

Key Risks

- The degree to which URET capabilities will be used operationally is dependent on the implementation of procedural and cultural changes.
- Interface with ongoing development of Traffic Management Initiatives.

ER-7.2 Metering and Merge Planning

Decision support tools provide the TMC with a metering plan and the controller with information on the required delays for each aircraft (also see AD-4.1).

Scope and Applicability

- TMA (Traffic Management Advisor) is applicable for airports where arrival demand regularly exceeds capacity.
- TMA-SC (Traffic Management Advisor – Single Center) near-term and mid-term locations include: ZFW-DFW (complete), ZMP-MSP (complete), ZDV-DEN (complete), ZMA-MIA (operational), ZOA –SFO (operational), ZLA-LAX (complete), and ZTL-ATL (operational). Transition to time based metering (TBM) is required to complete ZMA, ZOA, and ZTL. . Transition of these sites to TBM will be dependent on sufficient Back Fill overtime availability.
- Additional arrival sites will require site specific adaptation. FFP2 plans to deploy TMA-SC to support arrivals at the following airports: ZME-MEM(IDU 5/1/06), ZKC-STL(IDU 12/1/06), ZID-CVG(IDU 11/15/05), and ZHU-IAH(IDU 8/15/03). In FY03 FFP2 will deploy TMA-SC to ZHU-IAH. ZID-CVG, and ZME-MEM will be deployed in FY2006. ZKC-STL will follow in FY 2007. The facilities should be fully transitioned to time based metering 1 year after IDU. The transition, however will be dependent on sufficient Back Fill overtime availability.
- TMA-MC (Traffic Management Advisor – Multi Center) will enhance TMA to work in areas where the airport is close to the center boundaries and where arrival flows interact with flows to other airports. RTCA recommended TMA for several sites that require TMA-MC capability, these include Washington area airports, N90 airports, PHL, DTW, SDF, BOS, and PIT. NASA is developing TMA-MC with emphasis on PHL airspace; this capability will be evaluated in 4 ARTCCs and PHL TRACON in FY 2003 and 2004. TMA-MC will provide advisory information to controllers which is similar to that provided by TMA-SC, with the enhancement that the advisories are available to controllers in multiple ARTCCs. These distributed advisories collectively implement a coordinated plan for managing arrivals to a given airport.

Key Decisions

- Priorities for TMA deployments beyond the current FFP2 Baseline.
- Investment decision to enhance TMA-SC baseline with TMA-MC functionality.

Key Risks

- NASA is currently researching TMA-MC. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- New York and Philadelphia redesign activities will result in changes to TMA adaptation and therefore work in these areas needs to be coordinated. Transition to use of metering tools

requires substantial facility commitment and resources for adaptation, procedural development, and training.

ER-7.3 Conflict Resolution and Planning Aids

Decision support tools will assist the controller's ability to resolve conflicts and to generate direct routes.

Scope and Applicability

- En route conflict resolution aids expand on the conflict probe capability provided by URET CCLD.
- Research is currently underway on a direct-to tool that identify instances where a more direct route will result in user savings and on conflict resolution aids that assist the controller in generating solutions. D2 evaluations are being conducted in phases, beginning in 2002 and continuing throughout 2003 and 2004. The initial focus has been on developing an operational concept for the use of D2 as an en route R-side controller conflict probe, trial planning tool, and flight plan amendment interface. Evaluations of D2 by the ATCP have resulted in an initial Ops Concept for an R-side D2 that is interoperable and complementary to the URET functionality on the D-side. Further evaluations are planned to flesh out this Ops Concept and derive the detailed requirements necessary to transfer D2 to the en route development contractors for integration into the NAS. A full investment analysis and deployment plan for D2 has not yet been developed; however, the most likely implementation scenario is for D2 to be integrated into the en route architecture as an ERAM Pre-Planned Product Improvement (PPPI).
- EDA has not yet completed the Technical Readiness Level 3 (TRL-3) criteria which trigger active FAA assessment of the tool. When EDA transitions from TRL 3 to TRL 4 (by NASA's schedule, in 2005), the FAA Free Flight office will engage NASA and a representative Air Traffic Controller user team to begin the evaluation and development of an FAA Ops Concept for EDA. As with all Free Flight R&D efforts, the Ops Concept will encompass EDA functionality as well as EDA's intended use in conjunction with other en route automation and decision support tools.

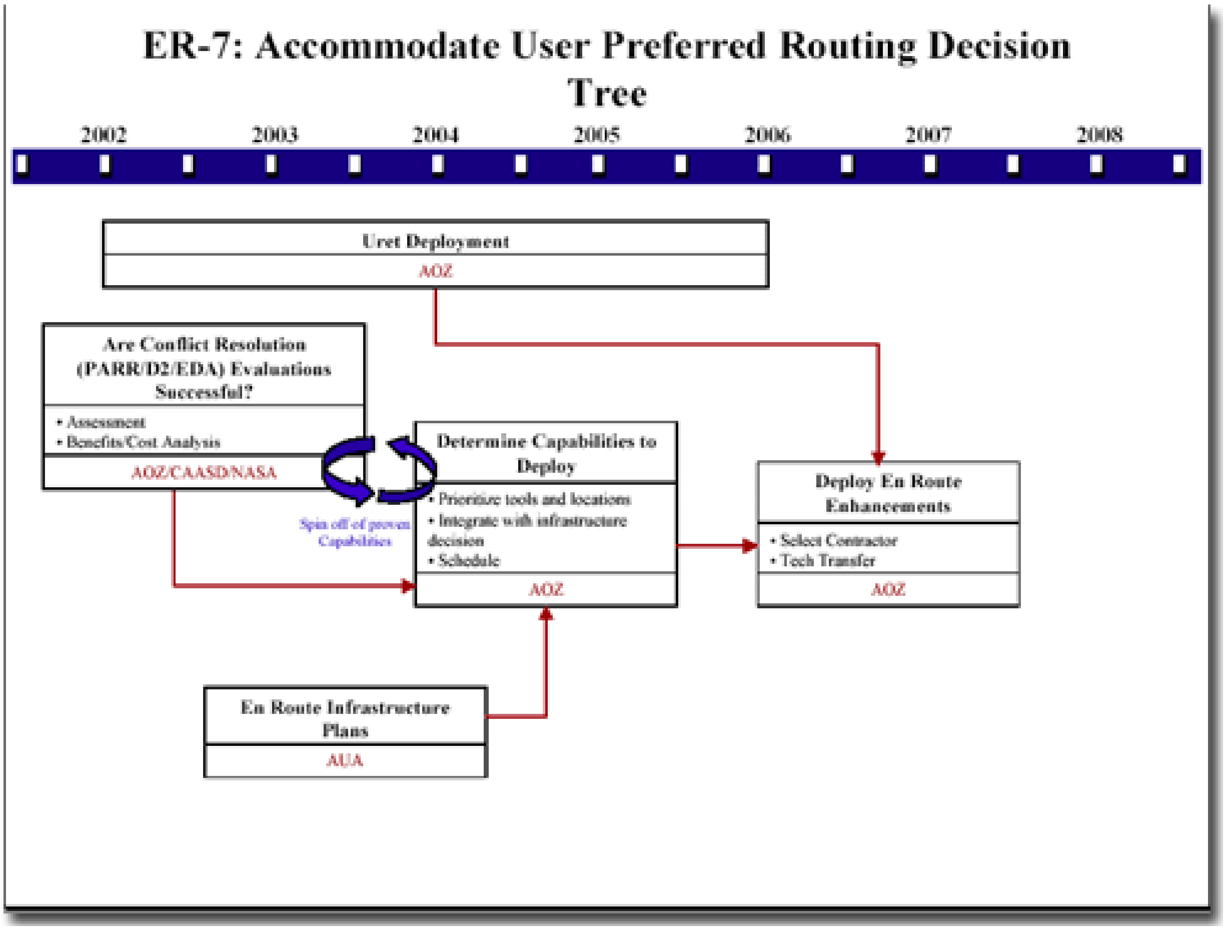
Key Decisions

None identified.

Key Risks

- MITRE/CAASD is currently researching conflict resolution aids (PARR - Problem Analysis, Resolution, and Ranking). Implementation is dependent on the success of this research and on CAASD participation in technology transition.
- NASA is currently researching a direct-to (D-2) capability. Implementation is dependent on the success of this research and on NASA participation in technology transition.
- Acceptance of automatically generated conflict resolutions may require procedural changes.

Decision Tree



[View enlarged decision tree]

Responsible Team

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John Thornton

Support Offices
ATP-1
AUA-200

Working Forums
RTCA
Interagency IPT

Other Websites
Relationship to the Architecture
RTCA Website
Free Flight Program Office